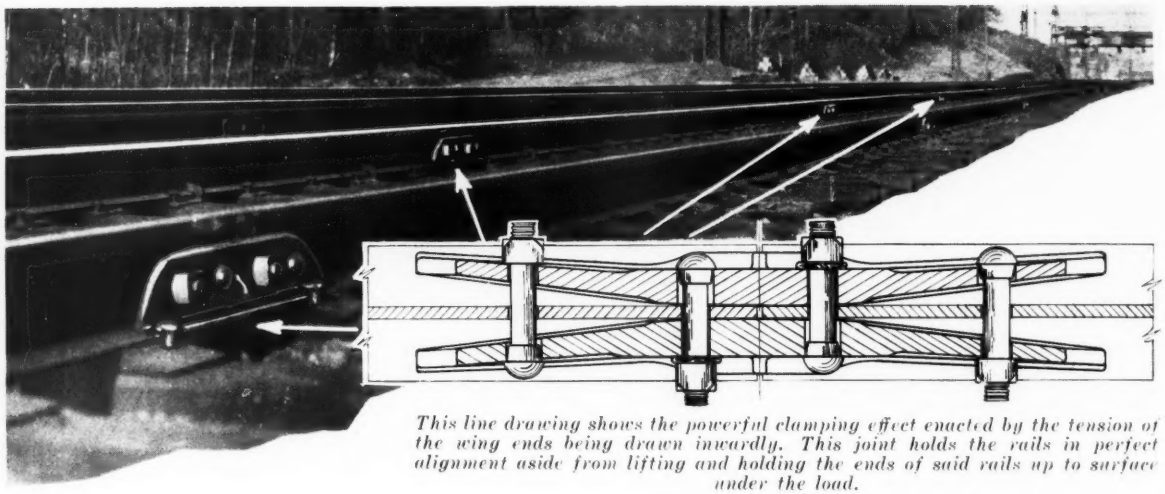
EQUIPMENT ECONOMIES NUMBER

Railway Engineering and Maintenance

March, 1932



This line drawing shows the powerful clamping effect enacted by the tension of the wing ends being drawn inwardly. This joint holds the rails in perfect alignment aside from lifting and holding the ends of said rails up to surface under the load.

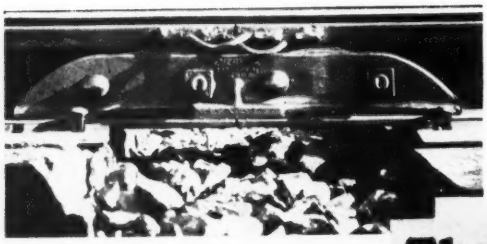
YEARS OF ADDED SERVICE TO WORN RAIL —LONGER LIFE FOR NEW

THE spring lever forged construction of the **EVERTITE** joint bar plus its holding and lifting power sustains the rail ends, arresting the destructive forces of impact and solves the problem of loose joints as well as the expensive complications which follow.

This modern rail joint with its adjustability contributes real economy in maintenance with added years of service for both new and worn rail.

The outstanding advantages of this improved design are in evidence by its use on twenty-five railroads.

Engineers in search of new methods for the reduction of track maintenance will find the answer to many of their problems in the use of **EVERTITE** Rail Joints.

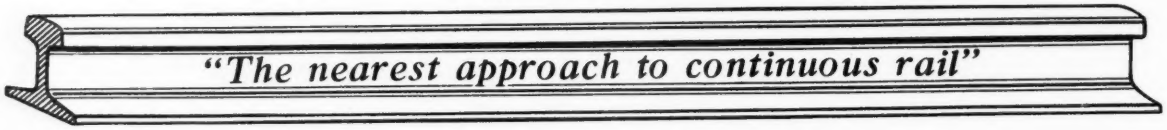


Complete Details
And Performance Records
On Request

STANDARD EQUIPMENTS INC.

415 Lexington Avenue NEW YORK

The EVERTITE Rail Joint



RAILWAY ENGINEERING AND MAINTENANCE
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Alphabetical Index to Advertisers, Page 226

6 CROSS TIE BULLETIN *January, 1932*

Roads Saved $33,000,000 on Cross Ties in 1929

Further Saving of $22,000,000 in Annual Renewals Held Possible

ACCUMULATED benefits from the practice of protecting cross ties from decay and wear were responsible for saving at least $33,000,000 for the Class I railways in 1929, states the Railway Age, in one of a series of articles on operating economies. In that year, according to statistics of the Interstate Commerce Commission, these railways renewed 74,679,375 cross ties at a total outlay of $100,585,843. Seventy nine per cent of these ties, or 59,047,380, were replaced by treated ties that cost $1.46 in track, while the remainder (except for a few steel and concrete ties) were of untreated wood that cost $0.93 in place. The renewals in 1929 represented an average replacement of 209 ties per mile of track (excluding the mileage laid with switch and bridge ties) out of a total of 2,974 ties per mile, which is equivalent to an average life of 14.2 years. If the railways had previously made all their renewals with untreated ties giving an average life of 7½ years, thereby requiring the annual renewal of 400 ties per mile, they would have been compelled to replace about 143,000,000 ties in 1929, which at a cost of $0.93 in place, would have required an outlay of $133,000,000.

This accomplishment is by no means all that the railways can expect as the result of proper preservation and adequate protection of their ties. The attainment of a life of 14.2 years is only a fair performance compared with the results obtained on individual railways, some of which are renewing less than 100 ties per mile per year. It, therefore, the Class I railways should obtain an average life of 20 years from their cross ties, and this is by no means an unreasonable assumption, for it is already being exceeded by several roads, their annual requirements would amount to about 150 ties per mile, and they would then need to replace only 53,500,000 ties (on the basis of the present Class I mileage), which, at a cost of $1.46 per tie, would represent an outlay of $78,100,000. Thus, it is not at all unreasonable to assume that they can effect a still further saving of at least $22,000,000 in their annual tie renewals.

Whether this saving or an even larger sum is to be realized will depend on the extent to which the roads as a whole adopt, and rigidly adhere to, the practices observed by those roads which are now obtaining the longest life from their cross ties. There is no short cut to good results. Rather, the answer is to be found in scrupulous attention to details—a purchasing policy that embraces a rigid adherence to specifications as to both size and freedom from decay, collection and yard-age practices that will insure against decay after delivery, treatment that is adequate and adapted to the climatic conditions of service, effective protection of the ties from mechanical deterioration and supervision of the track forces that will insure against abuse and premature removal. These measures seem almost too obvious to deserve mention, but there is ample evidence that deviation for "practical" or "business" reasons has not infrequently resulted in a loss of useful tie life which far outweighed the temporary

There is opportunity also to improve the protection afforded the ties against mechanical deterioration. Larger tie plates of better design, with faster

plate relative to the tie are among the developments of recent years that will make for longer service life of cross ties. The railways that have made the longest use of these more advanced forms of construction are among those that now enjoy the lowest tie renewal records.

Specify LUNDIE *for* BETTER DESIGN

There is opportunity also to improve the protection afforded the ties against mechanical deterioration. Larger tie plates of better design . . . will make for longer service life of cross ties.

THE Lundie Tie Plate has that better design—therefore insures the utmost in tie conservation—maximum tie life—minimum tie renewals.

This scientifically designed plate has a canted bottom with well-rounded parallel undulations which hold track to rigid gauge. The Lundie is the ONE plate, which under heaviest loads, merely compresses the fibres of the ties—NEVER CUTS THEM. The Lundie never splinters the timber or cuts deep pockets which hold water, start and accelerate decay. Therein lies the supremacy of the Lundie design.

The economical distribution of the metal in the Lundie Plate insures maximum strength at minimum cost.

Specifying Lundie Plates now will insure immediate as well as continued economies.

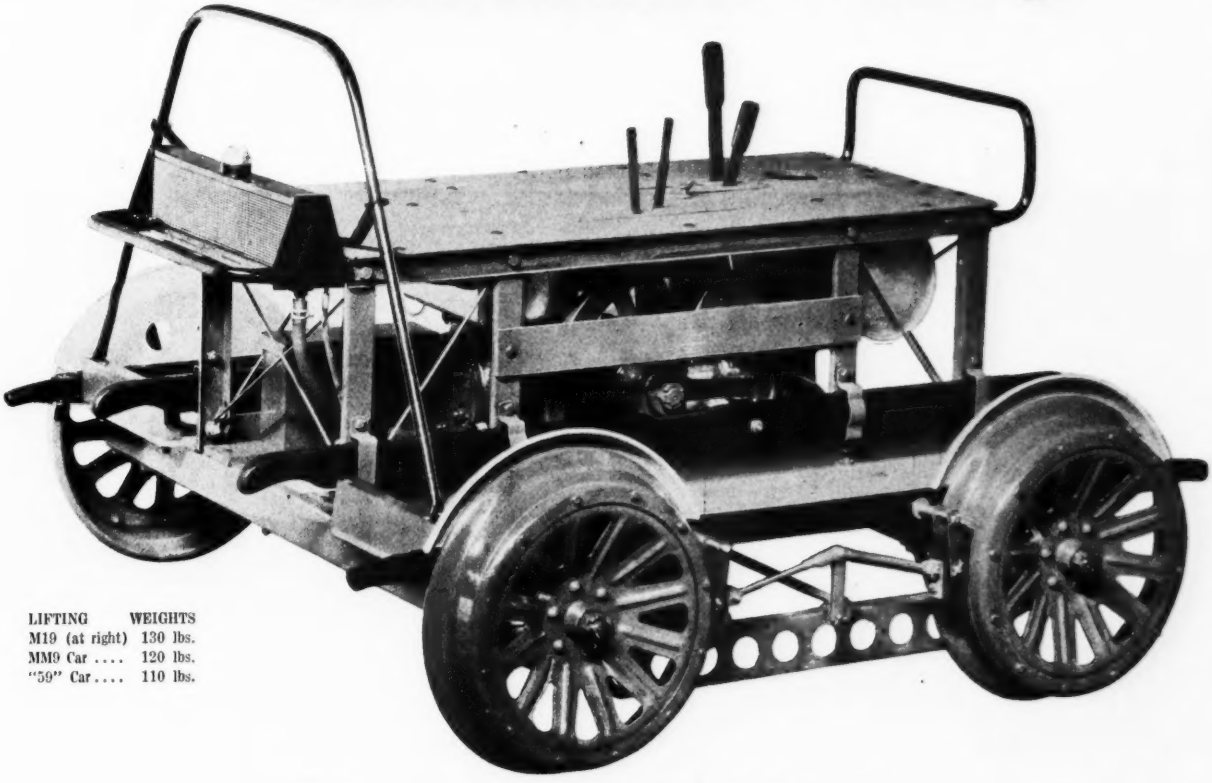
The Lundie Engineering Corporation

285 Madison Avenue, New York
59 East Van Buren Street, Chicago

150,000,000 IN SERVICE PROVE THE ECONOMY OF THE LUNDIE PLATE

LUNDIE TIE PLATE

The Fairmont M19



LIFTING	WEIGHTS
M19 (at right)	130 lbs.
MM9 Car	120 lbs.
"59" Car	110 lbs.

Meets Today's Needs

Light cars are needed today to make frequent track inspection easy and safe for one man alone, and to speed up maintenance where forces cannot handle heavy cars.

Such light cars need large reserve power for hauling increased gangs in summer.

Light cars are needed with three classes of bodies: (1) for one or two men, tools and material; (2) with springs for long trips, comfort for five men (see M19 above); and (3) real section cars with safe, long, deep trays for lining bars, seating six men.

Fairmont offers you all these bodies with the powerful 8 H.P. engine shown above, in four different cars which are all serviced from one small parts stock.

These cars easily pull a standard windshield. Ask the men now using light cars.

No matter what your motor car needs may be, write us for lasting satisfaction.

FAIRMONT RAILWAY MOTORS, INC.
FAIRMONT, MINNESOTA, U.S.A.

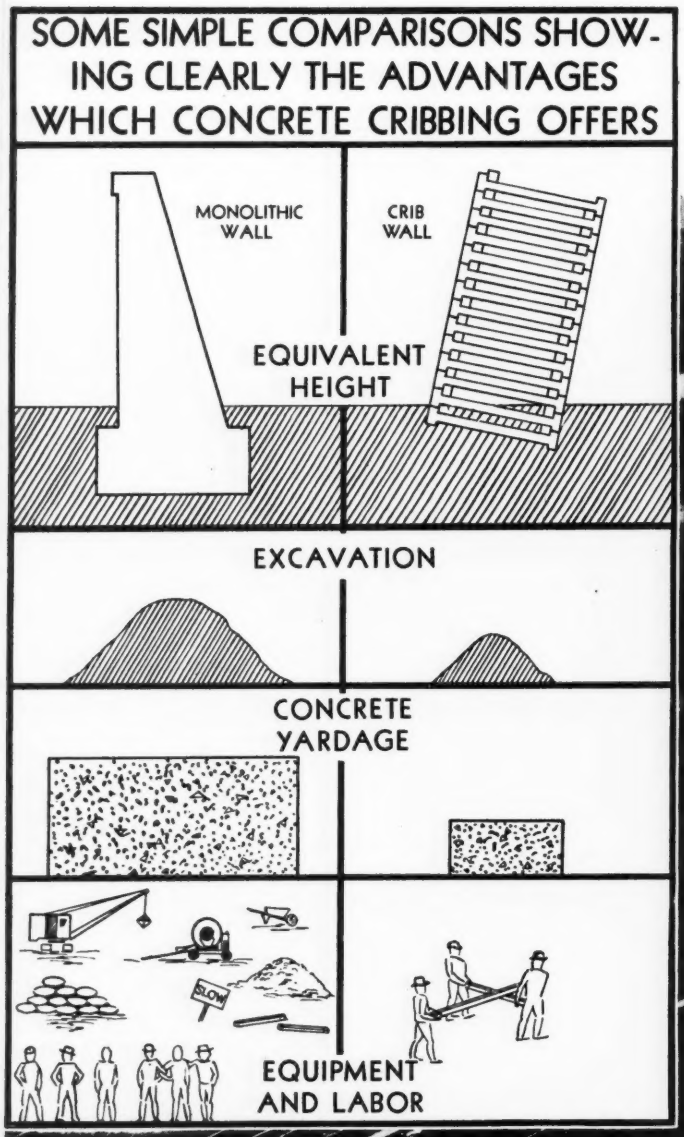
General Sales Offices: 1356 Railway Exchange Building, CHICAGO
District Sales Offices: Washington, D. C. St. Louis San Francisco
FAIRMONT RAILWAY MOTORS, Ltd., Toronto, Canada
Foreign Representative: THE BALDWIN LOCOMOTIVE WORKS

Manufacturers of section motor cars, inspection motor cars, gang and power cars, air or electric, paint spray, tie tamping, etc.; ball and roller bearing engines, push cars and trailers, roller axle bearings, wheels, axles and safety appliances. Also 4- and 6-cylinder rail coaches; gas-electric Moguls and Ballast Cleaners; mowers, discers, rooters, graders, weed burners, and extinguishing cars.

Performance on the Job Counts

THE RAILROAD WORLD KNOWS FAIRMONT

"Concrete for P



Permanence"

The large view shows two parallel walls of Massey Concrete Cribbing installed by the Delaware, Lackawanna & West. in Jersey City, N. J. The illustration at the right is a close-up of a Lackawanna wall being built in connection with the same improvement.

Retaining wall erected by the Pennsylvania Railroad at Pittsburgh, of Federal 2-Piece Concrete Cribbing Units. Note the splendid curve produced with this construction, through the use of standard units. The above is but one of many similar walls erected by this road over a period of years.

The Retaining Wall *for* 1932 Budgets

A precast wall ***costs less to build*** than poured concrete—and a ***2-piece*** precast wall offers savings beyond all other constructions.

Federal 2-piece design provides a wall as strong, stable and permanent as a poured wall—without the extra expense of form work, stripping, rubbing face, costly foundations. It offers 100% salvage if the wall is moved.

Compared to other cribbing constructions, handling but ***two*** units saves labor in erection—and the distinctive Federal ***closed face*** not only saves maintenance costs, but produces a fine masonry-like appearance that helps to beautify any right of way. A Federal wall actually improves with age—will never need to be replaced. It is a real asset.

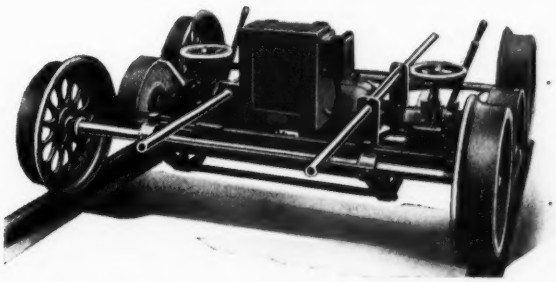
Proof of this outstanding value is apparent in an ever-increasing popularity. In 1931, there were more Federal walls erected than in any previous year! Let us submit full data for comparison.

FEDERAL-AMERICAN CEMENT TILE CO.

Executive Offices: 608 South Dearborn Street - - - - - - - Chicago
Plants near CHICAGO - NEW YORK - PITTSBURGH - BIRMINGHAM

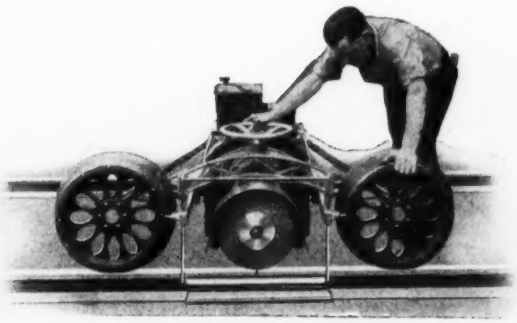
Concrete Products *for Over 25 Years*

FEDERAL 2piece Concrete CRIBBING



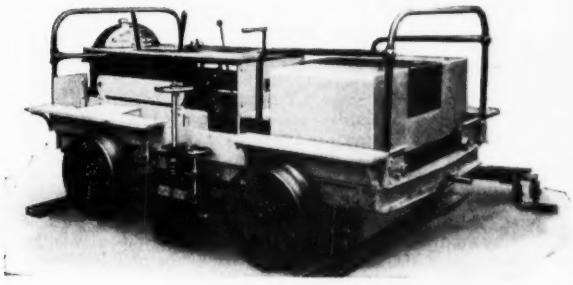
Railway Track-work Company Portable Track Grinder, Model P-2

Two grinding heads operating independently, one on each rail. Electric motor driven. Grinding wheel operates at 9000 surface ft. per min., feed regulated by hand wheel. Grinds gauge line or outside of rail. Derailing rollers raise grinder clear of track.
P-4 same as above except operated by gasoline engine.



Railway Track-work Company Portable Track Grinder, Model P-3

Grinding wheel operates on either rail. Single throw hand lever operates a jack enabling operator to swing machine for grinding opposite rail. Grinds gauge line or outside of rail at 9500 surface ft. per min. Electric motor driven. Quickly adjusted roller permits speedy derailing. Model P-6, same as above except that it is operated by a gasoline engine.



Railway Track-work Company Portable Reciprocating Grinder, Model P-7

Propelled and operated by 40 h.p. Ford Industrial gasoline engine. An economical machine for surfacing joints in new track. Grinds by reciprocation instead of rotation. Produces a smooth surface, maintains original rail contour, removes minimum metal. Two grinding blocks on each rail make 200 strokes per min. Quick derailing.

Economy-promoting equipment for rail maintenance

Machine shop economy and precision are now available anywhere on your roadway for producing a good-as-new rail surface after welding.

Old methods cannot equal the quality of work and the economies these machines offer.

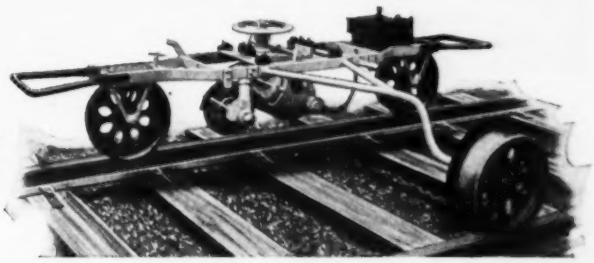
Machines in service on important lines are more than confirming the judgment of the purchasers.

Let us tell you who has bought them and send you complete data.

Railway Track-work Co.

3132-48 East Thompson Street Philadelphia

Descriptive literature on request



Railway Track-work Company Portable Electric Track Grinder, Model P-8

Two wheels on one rail. Outrigger on opposite rail, quickly removable, permits grinder on neutral ground to pass train. Electric motor operates grinding wheel at 9000 surface ft. per min. Adjustable laterally and vertically. May be reciprocated 16-in. Flexible shaft carries grinding wheel for beveling joints.

NORDBERG TIE ADZERS

Business was "off" . . . . .

NORDBERG SPIKE PULLER

so they equipped every gang with Nordberg Track Machines

Early in 1931, a Class 1 Railway ordered two Nordberg Spike Pullers and two Nordberg Adzing Machines.

They were used continuously, subjected to the most severe service, and proved to be exceptional money-savers.

These machines proved their own case—proved they were a primary necessity—proved that the Railway couldn't afford to get along without them *under present conditions.*

This railway has ordered Nordberg Spike Pullers and Adzing Machines for every gang—to help them through one of the most critical periods in railway history.

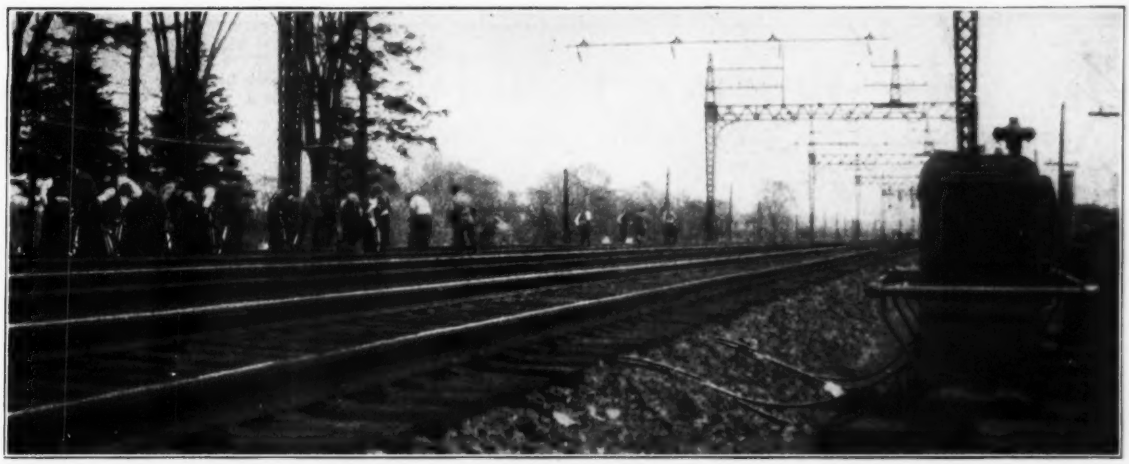
Investigate—you'll find your Railway *can afford* Nordberg Track Machines

Railway Equipment Department

NORDBERG MFG. CO.

MILWAUKEE WISCONSIN

NORDBERG



2-8 TOOL OUTFITS COMBINED AND WORKING AS A 16 TOOL UNIT

ELECTRIC TIE TAMPERS

SYNTRON

PITTSBURGH, PA.

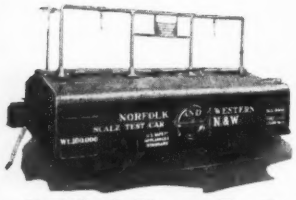
ELECTRIC TRACK TOOLS

BORING TIES AND DRIVING SCREW SPIKES

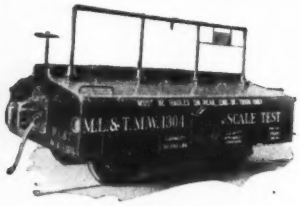
The Most Progressive Railroads *have adopted* SOUTHWARK SCALE TEST CARS

as standard equipment

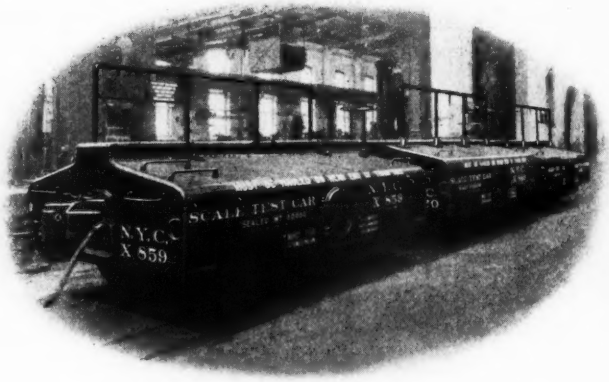
Detroit, Toledo & Ironton R. R. Co. (Ford Transportation Co.)



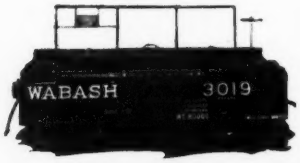
Norfolk & Western Ry. Co.



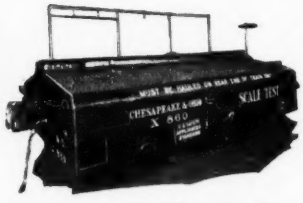
Morgan's Louisiana & Texas R. R. (Southern Pacific Lines).



Southwark Scale Test Cars are designed to comply with requirements of test cars in use by the Bureau of Standards, Department of Commerce, but also embody many improvements such as one-piece body, air brakes, spring equalization, etc.



Wabash Ry. Co.



Chesapeake & Ohio Ry. Co.

Illinois Central R. R. Co.

Some of the Railroads Using Southwark Test Cars

		Capacity, Pounds
Illinois Central R. R. Co.	1	80,000
Norfolk & Western R. R. Co.	2	100,000
Southern Pacific R. R. Co.	1	80,000
Chesapeake & Ohio R. R. Co.	2	80,000
Southern Pacific Lines	1	80,000
Wabash Railway Co.	1	80,000
Kansas City Southern Ry. Co.	1	80,000
Detroit T. & I. R. R.	1	80,000
Illinois Central R. R. Co.	1	80,000
New York Central Lines	1	50,000
New York Central Lines	1	100,000
Atlantic Coast Line R. R. Co.	1	80,000
Reading Co.	1	100,000
Chicago & Northwestern Ry. Co.	1	80,000

		Capacity, Pounds
Barney Machinery Co., Inc.	1	80,000
Union Pacific	1	80,000
M. K. & T. Railroad	1	80,000
Northern Pacific	1	80,000
Tennessee Coal & Iron Co.	1	100,000
Tennessee Coal & Iron Co.	1	50,000
New York Central R. R.	2	80,000
Southern Ry. Co.	3	80,000
Southern Pacific Co.	1	80,000
E. Ferro Central de Brazil	1	88,000 (40 Metric Tons)
Missouri Pacific R. R.	1	80,000
Great Northern Ry.	2	80,000
New York Central Ry.	6	80,000
Hocking Valley Ry.	1	80,000

BALDWIN SOUTHWARK CORPORATION-SOUTHWARK FOUNDRY & MACHINE CO. DIV.

SOUTHWARK
PHILADELPHIA

Stephenson's Rocket—1829

HISTORY REPEATS -

HISTORY repeats itself. Just as the successful performance of Stephenson's famous "Rocket" did much to promote the use of steam as motive power, so did the many apparent advantages of the first corrugated iron culverts encourage the research which finally gave to the world modern culverts of Toncan Iron—an alloy of refined iron, copper and molybdenum.

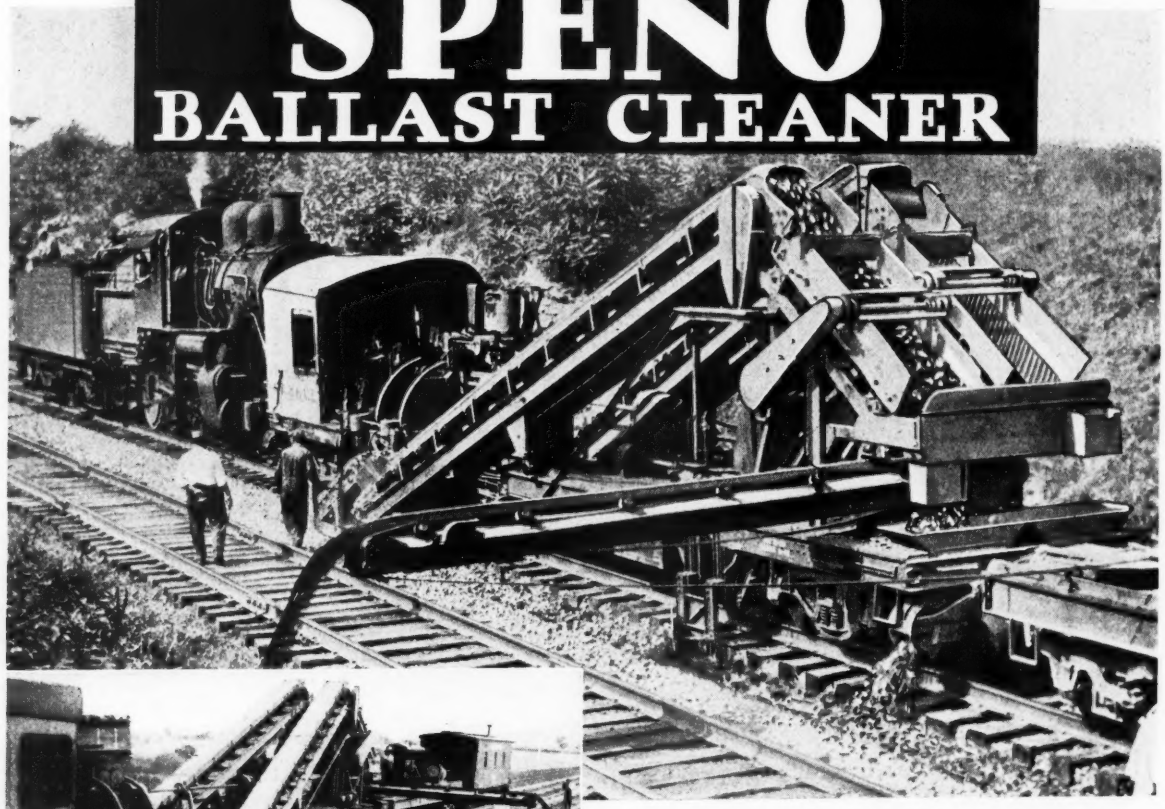
Every railroad, as a user of culverts, may rightfully ask, "What do the metallurgical improvements in Toncan Iron mean to me?"

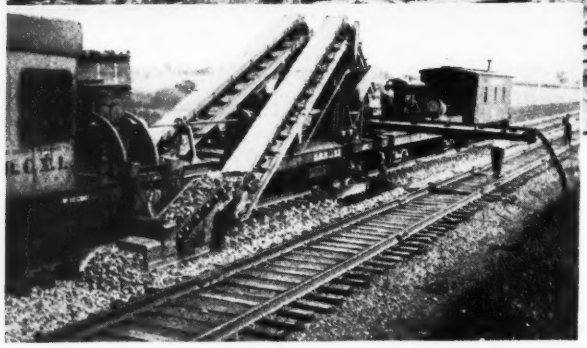
Just this—a culvert that will last longer even under severe conditions—a culvert that is equally resistant to corrosion through the entire thickness of the metal—that does not depend upon a surface coating for protection—a culvert that will cost less over the period of its longer life—that will cut maintenance costs—that is as far ahead of other culverts today as the first pure iron culvert was in advance of the ordinary steel culvert of twenty years ago. For economy in use—be definite and specify Toncan Iron for all future culverts.

TONCAN CULVERT MANUFACTURERS' ASSOCIATION
YOUNGSTOWN • OHIO

REG. U.S. PAT. OFF.
TONCAN
IRON CULVERTS

SPENO BALLAST CLEANER





SPENO BALLAST CLEANING SERVICE is fast, efficient, thorough, and above all, economical.

REQUIRES NO CAPITAL INVESTMENT. Speno service, including the Speno Ballast Cleaner, a foreman, an operator and a laborer, will clean your ballast on a lineal foot, mileage, time or any other contract basis.

DESIGNED BY PRACTICAL MAN with many years of experience. All component parts are ruggedly constructed and efficiently arranged for speedy, thorough and economical ballast cleaning.

OPERATION IS ECONOMICAL. The machine operates automatically after it is started. In reworking and cleaning the packed ballast, the machine returns a larger bulk to the track, thereby eliminating the need of adding new ballast to complete the section. The loose ballast also improves drainage.

SAFE IN OPERATION AND TRANSIT. The scoops on both sides can operate simultaneously without interference to traffic if track centers are 12 ft. 8 in. or more. The conveyor boom and scoops can be brought within clearance limits speedily to permit road movement.

CLEANS BALLAST
—Thoroughly
—Efficiently
—Economically

CLEANS BALLAST TO UNIFORM DEPTH. The scoops can be adjusted to any depth; they clear the longest ties and pick up a straight swath of ballast 27 inches wide and with a perfectly uniform bottom.

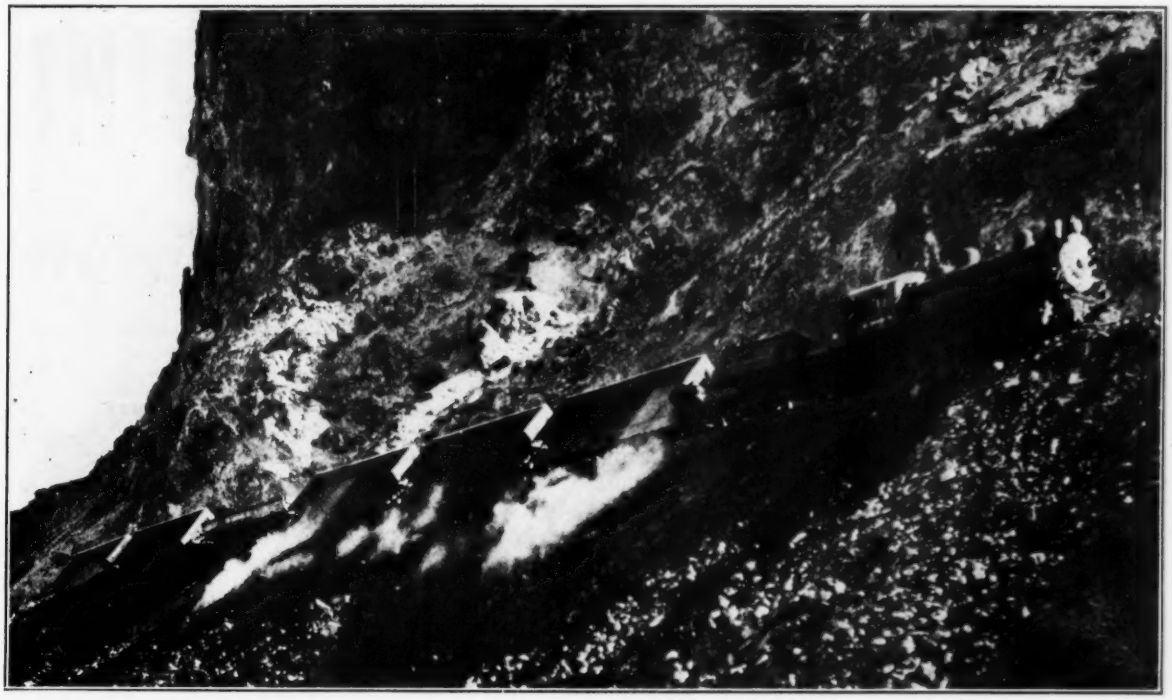
BREAKS DAM AT ENDS OF TIES. The fringe of uncleaned ballast along the ends of the ties is pushed into the center of the inter-track space by a scraper and picked up by the scoop when machine operates on adjacent track.

PROOF OF EFFICIENCY AND ADAPTABILITY. During last summer this machine cleaned 200 miles of inter-track ballast working one shift a day for 135 days or 810 working hours, operating only one of its sides at a time and clearing for traffic.

More detailed information appears in the January, 1932, issue of RAILWAY ENGINEERING AND MAINTENANCE. For complete description and prices of work write to—

FRANK SPENO RAILROAD BALLAST CLEANING CO.

628 WEST STATE ST. ITHACA, NEW YORK



Western Dump Cars Doing a Tough Job on Hoover Dam Project

Look at those Western 30-yard dump cars at Hoover Dam! More than fifty of them are at work on the great project. Look at the type of material they are handling. You railroad men can never ask more grueling service from your cars.

Western cars at Hoover Dam are hauling rock from the excavations and gravel for the concrete work. It is a tough job and Western cars are making good, as they have made good on practically every railroad in the country.

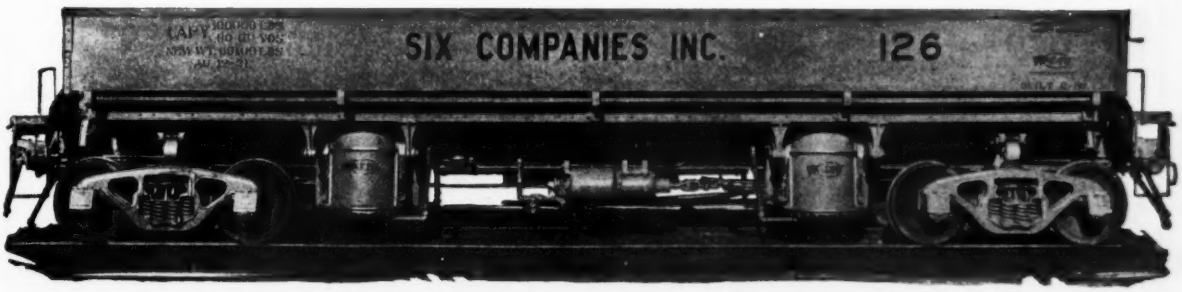
Follow their record on this great undertaking. They are handling all classes of material with economy speed and safety in far tougher work than is usual in railroad construction or maintenance.

Catalog 81-A describes these superb cars in detail. Where shall we send your copy?

WESTERN WHEELED SCRAPER COMPANY

Dump Cars and Grading Equipment

AURORA, ILLINOIS, U. S. A.



WESTERN

No. 39 of a series

Railway
Engineering and Maintenance
SIMMONS-BOARDMAN PUBLISHING COMPANY
105 WEST ADAMS ST.
CHICAGO, ILL.

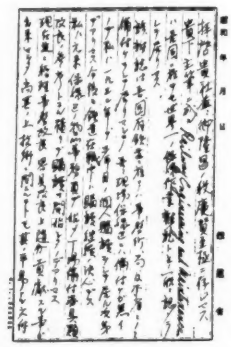
Subject: World Wide Interest in Mechanization of Maintenance Practices

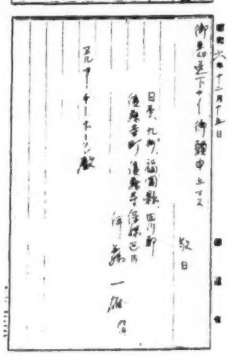
February 26, 1932

Dear Reader:

Among the letters that have come to my desk during the month were one from Moscow, U.S.R.R., and another from Fukuoka-ken, Japan. Interestingly enough, although coming from such widely separated points, these letters were similar in their desire for more information concerning American maintenance equipment. I reproduce below the letter from Japan, together with a translation of it.

The Letter





Its Translation

Fukuoka-ken, Japan
December 15, 1931

Dear Mr. Howson:

My congratulations on the continued success of your company. In fact, Railway Engineering and Maintenance has won distinctive recognition in Japan as the world's best magazine of maintenance in its field.

This magazine is distributed only at the headquarters of the Japanese governmental railways and to a few of the division officers, but none to the officers on the sub-divisions. In view of this fact, I have personally subscribed to your magazine for three years and shall continue my subscription as long as I hold this position. I am one of the sub-division clerks and my main purpose in subscribing to your magazine has been to secure sources of reference in order that I might improve the equipment and tools of my sub-division. The benefits which I have gotten out of this magazine are immeasurable, not only in the way of improvement of equipment but also in technical knowledge, due to its plain and clear manner of expression.

Among the 150 employees on this sub-division, I might say that only the superintendent can understand English. I translate the articles every night at home with the aid of a dictionary and have been lecturing at the monthly conferences on the subject of Foreign Maintenance, though I am a clerk and not an engineer. While there are some minor differences between the machines in use in your country and in mine, I am inclined to believe that the time will come when I can contribute tremendously in both theory and practice.

Will you kindly collect and send me catalogues of materials and of machines which are used in your country. Thanking you in advance for this matter, I am,

Very truly yours,
Kazuo Ito

Gotoji-Hosenku (Maintenance)
Gotoji-Machi

After reading these letters, I could not help but feel that the interest in the application of machinery to maintenance work, to which this issue is devoted, is world wide.

Yours truly,

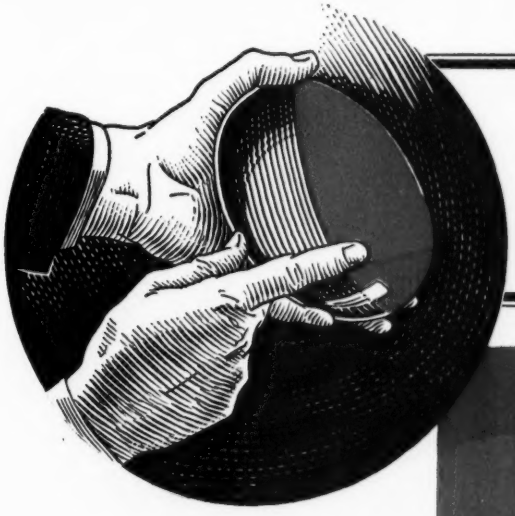
Elmer T. Howson
Editor.

ETH*JC

MEMBERS: AUDIT BUREAU OF CIRCULATIONS AND ASSOCIATED BUSINESS PAPERS, INC.

UNIQUE "SAUCER TEST"

proves RED-LEAD'S 4 *to* 1 *durability*



● Saucer used to make "Saucer Test" for paint durability. Made of steel, 5½ inches in diameter by ⅝ inch deep. Write for testing saucer and sample of red-lead. Prove to yourself that Dutch Boy Red-Lead is your property's best safeguard against rust.

● Dutch Boy Red-Lead is a fine, highly oxidized red-lead supplied in two forms—paste and liquid. The paste comes in natural orange red, is readily mixed to brushing consistency and can be tinted to darker colors. Dutch Boy Liquid Red-Lead (ready for the brush) is available in the natural orange red, two shades each of brown and green, and also in black.

● Here is an easy, practical method of determining the durability of paints for metal...a test that approximates service conditions and enables you to tell just which paint has the greatest wearing properties.

It is called the "Saucer Test" and was developed by railway maintenance engineers as a laboratory parallel to actual service conditions. In the "Saucer Test", the corrosive sulphuric acid reaction that takes place when cinders and moisture collect in the webs and pockets of metal structures, is closely simulated.

Small steel saucers are required to make this ingenious test. Half of each saucer is given a priming coat of Dutch Boy Red-Lead, and each of the other halves is painted with one of the other primers to be tested. Saucers are then filled with locomotive stack cinders and water, and placed in outdoor racks for a period of months. Water is added as it evaporates, and the saucers checked regularly and performance of each paint noted.

The railroad has tested scores of priming paints with the "Saucer Test"...and in every case pure red-lead has won by a margin of at least 4 to 1! Another railroad has made a similar test with brine solutions...with equally conclusive results. Red-lead has proved to be the most durable safeguard against rust whether caused by brine drip from refrigerator cars or by moisture and sulphur fumes.

If you would like to make the "Saucer Test" yourself...if you want to prove that Dutch Boy Red-Lead protects better—and longer—against the causes of metal destruction, we will gladly send you a testing saucer and a sample of Dutch Boy Red-Lead ready for the brush. Please make your request on your company letterhead.

• • •

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Railway Engineering and Maintenance

NAME REGISTERED U. S. PATENT OFFICE

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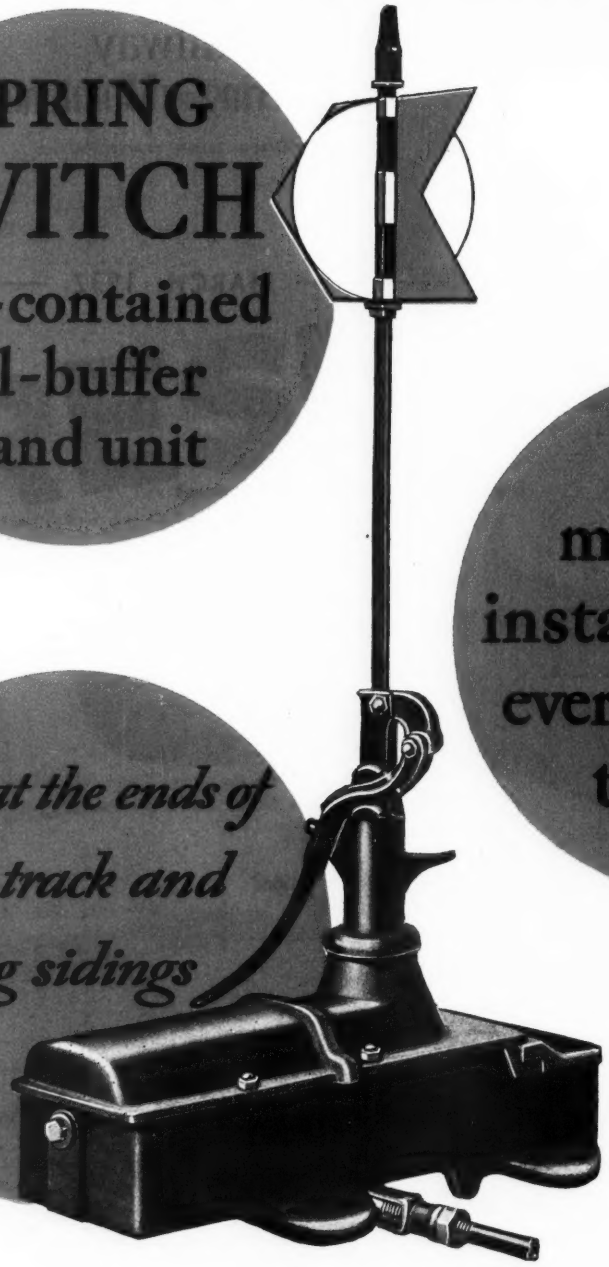
SPRING SWITCH

self-contained oil-buffer stand unit

Saves more than installation cost every month of the year

used at the ends of double track and passing sidings



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STYLE NO. 100-A

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RACOR

Railway Engineering and Maintenance

IRRESISTIBLE

The Mechanization of Maintenance Methods

FOR THE fourteenth consecutive year we are emphasizing in this issue the economies possible through the more complete mechanization of construction and maintenance of way operations. We are doing this with full knowledge and recognition of the fact that we are now in the midst of the most widespread period of unemployment in history, not only on this continent but throughout the world. This latter condition is a temporary one, however, which now appears to be lifting, while the necessity for the more universal application of power is a permanent and growing one, not only for industry itself but for the employee as well. It is important that railway employees of all ranks understand the scope and results of this trend in order that they may take no unwise attitude with reference to it but may, on the contrary, speed its development in order that its advantages may be realized.

A Machine Age

It is trite to say that we are in a machine age. Since the days when the Pharaohs built the pyramids by the most extravagant expenditure of human labor known, man has been striving to relieve himself of burdens by bringing to his aid mechanical assistance of one kind or another. But the machine age had its real beginning with Watt's development of the steam engine in 1765. It was further stimulated by Faraday's discovery of the principles of electro magnetic induction some 55 years later, leading to the use of electricity as a source of power. Since that time developments in mechanical equipment have followed one another in increasingly rapid succession until in the last decade progress has been so rapid as to lead to its characterization as the machine age.

No better example of the beneficial effects to employer and employee alike of this trend could be desired than a comparison of conditions in China, with its lack of development in this respect through the centuries, with those in America where change has been and still is the order of the day. In China, mechanical aids to supplement human effort are practically unknown. All work is done by hand; yet in spite of this fact there is a constant surplus of labor that far exceeds that which temporarily prevails here. Furthermore, as a natural result of such a condition, wages in China are so low that a workman earns only enough to permit him to purchase the barest necessities and is unable to buy those other things which we consider essential to our standard of living and which, in their production, give employment to so many other men.

An Ever-Increasing Development

Nor is this trend towards the mechanization of industry one that can be arrested with safety to either management or worker. It is an ever-continuing development that must be pressed if disaster is to be avoided. As an illustration, it is not long since England stood at the forefront of the nations in commerce, drawing in the raw materials from many nations and converting them into finished products for distribution to the four corners of the globe. Its methods were for a time abreast of the best and, as a result, it dominated the world's markets. But there came a time not long ago when English conservatism led to a retardation, if not an actual cessation, in the development of improved methods of operation. Other nations, notably America, continued to develop their methods in the meantime, to replace relatively new machinery with still newer inventions, and to introduce machinery where none had been used heretofore, with the result that the workmen of America have prospered greatly in this period and enjoyed a scale of living approached by the workmen of no other nation.

It Applies to the Railways

What is happening in world industry and in the factories of America is occurring likewise on the railways that serve these factories. Measured in ton miles—the product of a railway—the output of the individual employee is increasing. It is increasing not because of greater effort or exertion but because of the more numerous and more effective aids placed at his disposal. By reason of the more durable materials and the more efficient mechanical devices provided for him, he is, on the contrary, required to expend less effort. In other words, this equipment is eliminating much of the drudgery for him.

What maintenance man would desire in this day and age to discard the power shovel and dump car and return to the wheelbarrow and hand shovel as grading equipment for roadbed construction? Or who wants to mix by hand the concrete required for a massive bridge abutment? Ask the foreman who patrols his section on a motor car if he would willingly return to the old back-breaking hand car, or the man operating a rail crane if he prefers to handle rails all day long with tongs. No,

machinery is here to stay and those men in the gangs who use it are its strongest advocates.

Again, if the railways are to continue to survive and to provide employment in the years to come, they must prosper and they cannot prosper if they do not meet the competition of other transportation agencies. The railways no longer have a monopoly on transportation service. The buses and the trucks are challenging them at every crossroad, the waterways are becoming an increasing menace, and aviation is not to be ignored. In this competition for the traffic of the shipper, cost of service is all important. If the railways are to meet this competition and retain the traffic, it will be through the elimination of every unnecessary cost, whether it be in train movement, in traffic solicitation or in roadway maintenance.

If the railways fail in this struggle for traffic, they will no longer provide employment for even those now on their rolls. One needs no better demonstration of this than the drastic decline in employment that has occurred since the depression in business set in late in 1929. Lack of traffic rather than any widespread substitution of machines for men has been the cause for the laying off of more than 600,000 railway employees in the last two and one half years, for in this period the utilization of mechanical equipment has been no greater and probably somewhat less than in the years that preceded 1929. No small part of the decline in this railway traffic has been due to the loss of business to the highway and to the waterway. It is to the interest of every employee, therefore, that the railways adopt every measure to increase the efficiency of their operations in order that they may retain and regain their traffic and thereby continue to be going concerns and continue to provide employment.

Greater Output Increases Earnings

There is still another consideration that is of interest to every maintenance of way employee. It is the increased productivity that comes through mechanical aids. A power jack, a track liner, a power saw, or any one of the growing number of devices enables a man to turn out more work. Over a period of years this increased output is reflected in higher earnings for the employee—not to the individual alone, but to the group of which he is a member. This has been the history of industry. It will continue to be so. Not only does equipment therefor remove much of the drudgery for the man in the gang, but it also ultimately increases his earnings and his standard of living.

It will be pointed out by some that the use of equipment decreases employment. This is, of course, the immediate result, for if economy is to be obtained through the use of a machine, some men must be replaced. However, the construction of this equipment in the factory requires labor and men must be employed there, more highly skilled and able to command a higher wage. Men must also be employed by the railways to maintain and keep in repair this equipment. Furthermore, as stated above, through the increase in wages that inevitably comes ultimately to the employee who uses the new equipment by reason of his increased productivity he is enabled to come into the market for luxuries of one kind or another which he would not otherwise afford, and labor is again given employment in the production of these luxuries. This has been the history of American development and it will continue to be so as long as we continue to forge ahead.

Trend is Inevitable

The trend towards the more complete mechanization of industry in America is inevitable. The railways must participate in this trend if they are to keep pace with and to serve American industry and if they are to survive in the competition with the newer forms of transportation. Those employees who foster and aid in this development by the most efficient use of the equipment at their disposal not only recognize the inevitable but contribute also to the ability of the industry from which they derive their livelihood to continue to provide employment for themselves and their fellows. They also relieve themselves of much drudgery and reduce the exertion required of them by using these aids.

It is in the interest of the employees, as well as the railways, that we have promoted and will continue to promote the more intelligent and complete utilization of mechanical equipment of proven merit. It is with this objective that we present our fourteenth annual equipment economy number.

WELDING COSTS

A Better Basis for Comparison Is Needed

WHAT does it cost to build up a battered rail joint by welding? Efforts to answer this question have been the source of bitter controversies and of acrimonious discussions of the relative merits of oxy-acetylene and electric arc welding and of contract and "company" work. And the record indicates that the parties to these differences of opinion are no nearer to agreement than they were five years ago. However, it is not amiss to call attention to the primary cause for misunderstanding and this may be set forth by asking another question—What constitutes a properly welded joint?

Those who have had the widest experience in restoring battered rail ends are agreed that the best and most economical results are obtained if the welding is done before the irregularity in the running surfaces of the rail has become excessive. Obviously, more work must be done to correct a badly battered rail end than one that is not battered so much. But even in correcting a specific amount of batter there is opportunity for a difference of opinion as to the amount of work that must be done to get a good job. That this has far reaching results is indicated by the fact that the average cost of welding has been found to differ widely on three major units of one large railway system, and the further fact that investigation demonstrated that these differences in cost are roughly proportional to variations in the average amount of work done per joint. This was evidenced primarily by differences in the average length of rail surface welded, although refinements in practice are also involved.

This is of no great consequence if the work is done by

company forces, because the return realized is approximately proportional to the cost, except that a cheap job is probably not worth what it costs even if the cost is low. In the case of contract work, however, awarded at a fixed price per joint, it makes a big difference to both the railroad and the contractor, with the result that the bidder has usually tendered a price that is sufficient to cover any quality of work that may reasonably be required of him. Furthermore, he must in his own interest name a price that will enable him to do work of a character which in his opinion will produce effective results.

This raises the question of the practicability of measuring performance in building up battered rail ends for both company and contract work, in terms of linear inches of welding done, rather than the number of joints welded. In contract work this plan implies the assumption of the responsibility and authority for determining the extent of each weld by a representative of the railway company, but this should involve no serious obstacle to effective progress of the work, and should result in a lower average cost per joint than that now prevailing in contract work. In work by company forces, also, cost accounting on the basis of linear inches of welding done would afford much more accurate comparisons of the performance of different gangs, and of company work with contract work.

PAINTING

The Spray Gun Is Worthy of Wider Use

THE spraying of paint received its first impetus under the enormous pressure of war emergencies and with the revolution that followed the introduction of modern lacquers it gained a place in industry from which it can never be supplanted by the bristle brush. Progress in the application of paint with spray guns on the railways has, however, been far less pronounced. Freight cars and, to a lesser extent, passenger coaches are being painted mechanically, but in bridge and building painting, the transition from the brush to the spray gun has been even slower, although probably no slower than on similar structures beyond the right-of-way line.

The spray gun was employed to a minor extent on bridges and buildings as long as 15 years ago, but under circumstances that were distinctly unfavorable to its widespread adoption. However, thanks to experience gained since that time, the status of spray painting is now on an entirely different plane. Spray equipment has been greatly improved. Nozzles are reliable in action, operate with a minimum waste of paint, are capable of applying liquids of a considerable range of viscosity and provide the desired selectivity in the shape of the spray delivered to the surface. Auxiliary equipment has also been perfected, compressors of sizes and types suited to spray painting have been brought out, and, what is more important, the air compressor has come to be recognized as a requisite for much maintenance of way work. Moreover, railway organizations have become mechanically minded, men have been trained to use machines and definite provision has been made for their upkeep.

As to the results: The spray-painting method has now been applied on enough railways to show that is is economical, that it produces a real saving in labor and, contrary to the popular impression, that no more and, in not a few cases, less paint is consumed than with brush painting. With respect to the durability of the film applied, the evidence is not so conclusive, although it is clear that there is not enough difference in the relative protective value of brush and spray applied paints to influence the decision in favor of one process or the other. There is as much information supporting the superiority of spray-applied coats as there is in favor of brush-applied paints. In brief there is now ample data on spray painting to serve as an impetus to the further adoption of the process.

PREPARATION

Of Importance to Well-Organized Effort

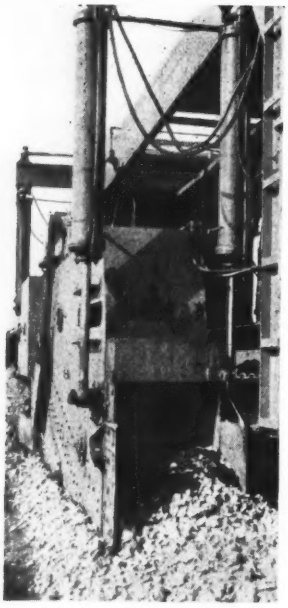
ADEQUATE preparation before a job is started will do much to increase the efficiency with which the work can be done. At present, advance preparation becomes of larger importance to insure that there will be a minimum of lost motion in every phase of the maintenance program.

Tie renewals are a case in point. They constitute one phase of maintenance for which it is generally considered that little advance preparation can be made by the section forces. There are certain things, however, that can be done, which will aid greatly later in the season and will tend to shorten the time required to complete this part of the season's program. This preparation should start with the tie inspection, months before the actual renewals get under way. At this time the foreman should divide each mile into relatively small units, the simplest method being to base these divisions on the intervals between telegraph poles.

If the number of ties that are needed, say for each two or three-pole interval, is recorded, this information will be of assistance in obtaining a correct distribution when the ties are received and will thus minimize the amount of trucking that will be necessary to obtain exact distribution.

It is desirable where this is practicable, to have all ties on hand before the renewal program is started since this will avoid interrupting the work to do unloading. Also, if the ties are received well in advance, they can be placed in small piles close to the point of use, to improve appearances and reduce the fire risk. If they are received only a short time before use, however, the individual ties should be spotted opposite the point of insertion. The important thing is to have them where they are wanted and in position where they can be handled into the track in a minimum time and with a minimum amount of labor.

If the tie spacing is uniform, the gang can go over the section and shift anti-creepers to adjacent sound ties and thus save considerable time later. At this time it is also often feasible to prepare the jack holes that will be needed. These are only a few of the items that can be cared for in advance, which will have a bearing on the cost and time required to complete the tie-renewal program.



Ballast Cleaning by Machinery is Now the Subject of Intensive Study by Maintenance Officers of All Ranks

What Is the Demand for Labor-Saving

The volume of purchases to date—The degree of saturation—The needs not yet met

TO WHAT extent are the railways using work equipment? How much of this equipment has been purchased in the last five years? What purchases are in contemplation? How fully do the devices at present available meet the needs of the railways? What are the needs for equipment not yet designed or developed to the point of demonstrated practicability? These questions and others were asked of the maintenance officers of a number of representative railways in an effort to determine how far they have gone in providing such equipment, what their attitude is toward its use, what additions they expect to make in equipping their forces and whether the equipment now available is sufficient to meet the needs of railway maintenance or whether still further developments are necessary. Replies were received from 44 roads representing a total line mileage of more than 164,000.

It was not surprising that, with one or two exceptions based on special conditions, these officers were unanimous in their statements that the work equipment which they now have has not only demonstrated large savings, but that, in addition, the quality of the work has also improved. The answers to the question as to the unmet needs, however, contained several surprises which will be discussed later.

Current Purchases of Equipment

How much work equipment and in what variety are the railways purchasing? Based on replies in which specific figures of cost were given by 33 roads which have a total line mileage of approximately 124,000, the total purchases of all of the roads in the United States and Canada during the last five years have been more than $25,000,000. This is at an average rate of $5,000,000 a year. Included in this list are eight roads, each of which bought at the rate of $100,000 a year and thus spent at least $500,000 during the five-year period. In addition to these, two roads reported purchases of more than $800,000 each, or at the rate of $160,000 a year; a third road spent $875,000, or at a rate of $175,000 a year; while still another road made purchases aggregating more than $2,300,000 during the period, or at the average rate of $460,000 a year, with a maximum expenditure during one year of $1,150,000. Those roads which did not give specific figures as to their expenditures furnished sufficient detail as to the number, classes and types of equipment which they purchased, to indicate that, with few exceptions, they have been buying in substantially the same ratio as those that detailed their costs.

In considering these figures it should be kept in mind that not a few of these roads had bought large amounts of work equipment during the years immediately prior to 1927. This makes all the more striking the fact that in only a few cases were there large fluctuations in the purchases that were made from year to year by individual roads. On the contrary there was, in general, a steady and progressive increase in the amount of money spent annually.

Again, most of the purchases were for new equipment, although some of the roads stated that their older equipment is now reaching the point where, because of wear or obsolescence, it will soon become necessary to replace it. One of the roads which recorded purchases in excess of $800,000 in this five-year period, also spent more than $750,000 for repairs, including parts, and replacements. In fact, during the first two years of the period, considerably more was spent by this road for repairs and replacements than for new equipment. Nearly all of the roads reported that it is their policy to replace equipment with that of more modern design as soon as the cost of repairs reaches the point where its retention can no longer be justified economically.

It will be seen, therefore, that while there is already a large and attractive market for new equipment of almost every type, there is also an equally large and stable prospective market for repair parts, as well as for the complete units which will be required to replace worn out and obsolete machines and tools, and this market will increase as the number of units in service grows.

Wide Range of Work Equipment Purchased

Fully as interesting as the amount of equipment that is being purchased is the wide variety of machines and tools that are being placed in service. These devices range from self-contained machines which carry their own power plants, to small power-driven hand tools. On a following page is a list of some of the units of equipment which were mentioned.

It is obvious from the comments of many of the maintenance officers who discussed this phase of the subject that no tool is too small for consideration and no machine is too large or too expensive, provided it can be shown by reliable data that it will do as good or better work than is being done by present methods and will do it with sufficient economy to warrant the purchase.

What is the attitude of the railways toward expenditures for work equipment? The great majority of the railway officers profess to be alert to take advantage of

Equipment?

any opportunity to improve their performance. In recent years the pressure for greater economy in railway maintenance has increased to the point that even those few who are reluctant to change their methods are being forced to do so.

In the routine performance of maintenance and many of its allied tasks, it has been demonstrated so frequently as no longer to require comment, that one man operating a machine can do more work, and often can do it better, than four to eight men can do by hand. In fact, some classes of work, welding for example, are impracticable without the aid of work equipment. Railway officers are becoming increasingly aware of these facts, and as a result, the replies were unanimous that the roads represented are not only favorable to this form of expenditure, but are committed to the purchase of equipment commensurate with their needs. A few of the smaller roads qualified their answers, however, by stating that they do not have a sufficient amount of some kinds of work to justify the purchase of the large units which are required to do these tasks. A few also explained that local conditions prevented the use of certain kinds of equipment.

One chief engineer voiced the opinion of many of the others when he stated that although his road has been liberal in its purchases of work equipment, the need for additional units is still very great. "It is obvious," he said, "that all of these requirements cannot be filled at one time, but the purchases must be spread over a number of years, selecting in preference those types which will give us the greatest return in economy and performance."

The railways are spending more than $5,000,000 annually for engineering and maintenance of way work equipment and the trend is sharply upward.

Outstanding features of this trend are the open receptivity of railway officers, the remoteness of any point of saturation, the increasing expenditures for repair parts and replacements and the wide field for types of equipment not yet designed.

The railways are also demanding improvements in present equipment to insure greater dependability, to increase the range of adaptability, to decrease maintenance costs and to provide machines and tools that are lighter in weight.

A few roads reported that they were completely equipped with certain types of machines and that future purchases will be based on the needs for replacement of worn or obsolescent units. It is of interest, however, that not more than two or three roads reported saturation in any given type of equipment and even these roads gave lists of many other types of which they stand in need.

Many of the roads reported that they do not as yet have any units of certain types of machines and power tools, while they are partly or fully equipped with others. The replies indicate that the types that are being added include every class of equipment that is available and that they cover the full range of those which have been purchased during the last five years. It is also apparent from the replies that the development in some classes of equipment has been so rapid that machines which were purchased relatively recently are now considered practically obsolete. Several officers mentioned the fact that certain of their machines would have to be brought up to date or replaced, as later models demonstrate so much greater flexibility and efficiency.

Among the more forward-looking officers there is an obvious belief that the mechanization of railway maintenance is still in its infancy. They are frank to admit that the equipment that is already at their disposal has resulted in large savings and point out that they are now able to undertake some classes of work on a large scale, which they were forced to neglect or do on a relatively small scale when only hand methods were available. Despite these facts, however, they are of the opinion that many of the operations which must still be done by hand could be done better, more efficiently and in less time by machines or power tools, if the right sort of equipment can be designed for these purposes. They also point out that much of the equipment already in use needs to be revised radically before it can be expected to give complete satisfaction in the work for which it is intended.

They find also, as they gain experience in the use of the machines and tools, that some of them possess defects which should be corrected and that others are not properly designed to meet all of the requirements that are demanded of them. In other cases, it might be possible through minor changes or complete redesign to adapt them for a wider range of work and thus make them more useful.

Ballast cleaning is a case in point. Under hand methods this work was often left undone, or was undertaken, perhaps, on a small scale when it was no longer possible to avoid doing it. Cases were relatively common where the foul ballast was removed from the cribs and this, together with the shoulder ballast, plowed over the shoulder of the roadbed, preliminary to replacing it with new ballast and giving the track a general raise. This was a waste of expensive material, but in many cases there seemed to be no alternative, since the cost of cleaning was prohitive.

More recently, ballast-cleaning machines have been developed, which can be depended upon to clean the ballast shoulder effectively at low cost and on a large scale. One engineer maintenance of way indicated the trend of thought on this subject, however, when he said that there is a crying need for "ballast-cleaning equipment of smaller size and less costly design than the huge plants that are being used on a few of the larger roads." Several others call attention to the fact that while the present machines clean the shoulder ballast, the cribs remain untouched, and that usually they are as much in need of cleaning as the shoulder.

Several maintenance officers call attention also to the fact that "the problem of reducing the labor expense of renewing ties through the use of power equipment remains unsolved." Others indicate a definite need for a machine which will remove ties quickly and cheaply from the track during renewals, without disturbing the line or surface. A number mention the fact that little has been done to develop improved methods of mowing the right of way, and call attention to the need for more economical methods of weed eradication on the roadbed.

To reduce the amount of equipment and permit a greater use factor, a combination machine was suggested that could be used for either chemical weed spraying or for oiling the rail and fastenings.

A number of the replies indicate dissatisfaction with the present equipment for pulling and driving spikes, in the belief that "the equipment so far offered has not been developed to the point where it is able to justify itself." Another need that was mentioned frequently is some simple, inexpensive and more easily portable machines for tamping ties, which would be adapted for small section gangs. Another tool that is wanted by most of the roads is a bolt-tightening machine which can be put into the hands of section gangs for use in routine maintenance, and which can be depended on to give a uniform tensile stress in the bolts. Many officers are inclined to favor self-contained small tools which operate under their own power, as well as large self-propelled machines.

Work Equipment Bought During the Last Five Years

Air Compressors	Portable welding outfits
Air dump cars	Portable wood-working machines
Automobile trucks	Power-driven saws
Ballast cars	Power jacks
Ballast cleaners	Rail drills
Bolt tighteners	Rail oilers
Bonding drills	Revolving crawler cranes
Boring machines	Rock and concrete drills
Chemical weed sprayers	Sand-blasting equipment
Concrete buggies	Snow plows
Concrete mixers	Spike drivers
Concrete surfacers	Spike pullers
Crawler-mounted tractors	Spray-painting outfits
Cross grinders	Spreaders and ballast shapers
Ditchers	Steam shovels
Drag lines, both railway and crawler-mounted	Surface grinders
Electric generators	Switch heaters and snow melters
Flange and rail lubricators	Tie adzers
Gas shovels	Tie scorers
Hoisting machines	Tie-tamping outfits
Joint oilers	Trailers
Lidgerwoods and plows	Track liners
Light rail cranes	Tractor-drawn mowers, plows and harrows
Locomotive cranes	Trenching machines
Motor cars	Weed burners
Mowing and discing machines	Well drills
Pile drivers	

At present, hand labor is employed almost exclusively in trenching for subsoil drainage in cuts. Power equipment which will also provide means for installing lateral drains to water pockets under the tracks, is needed to reduce the labor expense of these installations. Representatives of the northern roads are desirous of equipment which will facilitate the removal of snow from team tracks, driveways, shops and stations and the disposal of snow in yards and elsewhere.

Present Equipment Too Heavy

Probably the most frequent comment with respect to existing equipment referred to its weight. Many maintenance officers are of the opinion that still better results can be obtained if they can extend the use of certain machines and tools to section gangs. They are in general agreement, however, that this is not now practicable with the equipment now on the market as it is too heavy and not easily portable, while it costs too much to warrant this widespread use. Among the tools mentioned in this connection were air compressors, electric generators, tie tampers, bolt tighteners, and spike drivers and pullers. A number of officers made similar comment with respect to equipment that is used in laying rail and ballasting, saying that future equipment of this character must be lighter to permit quicker and easier removal from the track.

In this connection, it is evident that there is a growing opinion in favor of machines that can be used without being confined to the track. It was pointed out that work-train service is expensive, while the delays that are always incident to this service reduce the number of hours that the work equipment is in actual use to a small part of the crew time. Particular mention was made of ditching and drag-line equipment, power shovels, cranes, weed cutters, weed destroyers, air compressors and generator sets. Complete freedom of movement for the latter two types, it was said, will permit them to keep pace with the gangs they serve and reduce the amount of piping or cable that is now necessary. Possibly it would also remove some of the other objections that were voiced with respect to the present form of this equipment.

What Will the Future Trend Be?

What direction will the developments in the work equipment field take in the next few years? This question was also asked, and the replies indicate that alert maintenance officers are giving much thought to the subject. They also indicate a somewhat wider difference of opinion than was expressed on the others. Some are of the opinion that it is more important to work intensively in an effort to improve the equipment already in use. They support this position by saying that there are few types of machines or tools from which they are now deriving all of the benefits which should accrue from their use.

Most of those who replied also cited the fact that the present equipment requires too much maintenance and that many machines are out of service too large a proportion of the time as a result of broken parts or excessive wear. The cost in delays to the work from having a machine or tool out of service may be many times the expense of the repairs, and these officers believe that the overcoming of these defects is of paramount importance. They also believe that many improvements can be made which will increase the efficiency of the machines while in service and that others will increase the range of their application.

Work Equipment, as yet Undesigned, Is Needed to Facilitate Tie Renewals

In discussing the future trend, A. C. MacKenzie, engineer maintenance of way, Canadian Pacific Eastern

Lines, said that, "It is to be expected that the trend in labor-saving equipment during the next few years will be toward refinement in the design of existing units, which will make for versatility and cheaper and easier maintenance, as well as a wider application of the existing types." H. R. Clarke, general inspector permanent way, Chicago, Burlington & Quincy is of the opinion that "The greatest development of the next few years will be a further improvement of existing equipment, including some which we consider is not yet perfected to the point of economical use, thus making it available for our use." A. Anderson, engineer maintenance of way, Chicago, Indianapolis & Louisville, also thinks "there is room for improvement in existing equipment." This is likewise the view of W. S. Burnett, chief engineer, Cleveland, Cincinnati, Chicago & St. Louis.

H. S. Clarke, engineer maintenance of way, Delaware & Hudson, believes "That improvements will be made through changes to derive power from fuel oil, and that there will be attachments to present and revised machines which will increase their range of application." Following the same line of thought, J. R. W. Davis, chief engineer, Great Northern, expects that "Rail flaw detection equipment, gas and Diesel excavators and mechanical track tools are likely to undergo substantial development and simplification, while the introduction of gas or oil-powered equipment, especially for bridge and building work, is particularly desired." He also looks forward to changes which will "permit the substitution of self-propelling equipment to eliminate the necessity for work trains."

A. N. Reece, chief engineer, Kansas City Southern, is convinced that "There is a general need for improvement in the mechanical details of much of our equipment to eliminate the time lost and reduce the cost which results from the necessity for frequent repairs." In the opinion of W. H. Courtenay, chief engineer, Louisville & Nashville, "The greatest development will be the improvement in the design of portable gas-driven units, such as full-revolving cranes, and toward lighter tie-tamping units than are now on the market." Thinking along the same lines, C. S. Robinson, engineer maintenance of way, Maine Central, believes that "Improvements will be made in existing devices to increase their reliability, dependability and economy of operation." He also expresses the opinion that "Heavy-duty cranes will be operated by means other than steam, but will retain the present advantages of this equipment; that ditchers and other equipment of the crawler-mounted type will be improved to make them independent of work-train service; that both gas and electric welding will be developed to a more-refined and economical performance; and that developments in the smaller power tools for track work will greatly improve their reliability and performance."

Similar views were expressed by G. A. Phillips, chief engineer of maintenance, Lehigh Valley; G. H. Harris, chief engineer, Michigan Central; F. S. Schwinn, assistant chief engineer, Gulf Coast Lines; E. E. Oviatt, chief engineer, New York, New Haven & Hartford; W. P. Wittsee, chief engineer, Norfolk & Western; and G. W. Harris, chief engineer, Santa Fe.

Look Forward to New Types

On the other hand, there are not a few officers who maintain that the field is as yet inadequately covered and that their principal need is for additional equipment which will enable them to eliminate hand methods in some or all of the operations for which there is not now any form of work equipment available. The matter of equipment for renewing ties, which has been mentioned, is an example of what they have in mind. This group of officers does not overlook, however, the necessity of further improving existing equipment, practically all of them having mentioned it.

In expressing his views on the probable trend, W. G. Brown, engineer maintenance of way, Florida East Coast, predicted that "The next few years will witness the introduction of new equipment for cleaning ballast, grading, ditching, oil spraying, bolt tightening, spike driving, spike pulling, field adzing of ties, laying rail and chemical weed spraying, and that further improvements will be made in the present equipment for these purposes, especially with a view to increasing their adaptability for a wider range of work."

An Example of Equipment That Is Now Virtually Obsolete

Among those who look forward to the development of devices for new purposes is A. F. Blaess, chief engineer, Illinois Central, who is facing a need for devices that can be used with tractors. He said that "We will see the development of new equipment for preserving rail ends and manganese frogs and crossings. There will probably be considerable development in electric tools and appliances which can be used with tractors, and these will be used to avoid the expense incident to work train service. I expect to see devices for using electricity in the disposal of snow and ice, especially around interlockings, at frogs, switches and car retarders, and possibly around passenger and freight stations."

G. A. Phillips, chief engineer of maintenance, Lehigh Valley, voiced the hope of many maintenance officers when he suggested the "possibility that a machine for excavating the ballast in the cribs will be developed." This expectation was also expressed by E. A. Craft, engineer maintenance of way, Southern Pacific, who also expects that "these developments will include equipment for reconditioning rails by welding, grinding and heat treatment." In addition to the improvement which he thinks will take place in existing equipment, Mr. Robinson is also of the opinion that "The rapidly changing aspect of railway work is producing a demand for new devices which will be met by the manufacturers, as they have met those of the past."

Developments of the near future, as forecast by A. A. Miller, engineer maintenance of way, Missouri Pacific, will be along two principal lines, these being, "Equipment for the purpose of surfacing and lining track, and

the introduction of satisfactory equipment which is free to move and do work without respect to tracks." Robert Faries, assistant chief engineer-maintenance, Pennsylvania, predicts that "The greatest development will occur in the introduction of new equipment." This is also the view of W. S. Hanley, chief engineer, St. Louis Southwestern, who believes, however, that the major part of this development will be in material-handling equipment. On the other hand, as J. L. Kirby, chief engineer maintenance of way, Seaboard Air Line, sees it, "The developments will be about evenly balanced between new devices, the better design of those now in use, and a better and more intensive use of the equipment that is available." Substantially the same view is taken by C. E. Weaver, assistant general manager and chief engineer, Central of Georgia, who said that "We will see a decided improvement in all classes of roadway machines we are now using, while new equipment will be introduced gradually."

As W. J. Backes, chief engineer, Boston and Maine, foresees the development of the near future, they will be directed toward the reclamation of worn and battered rail, switches, frogs, crossings, rail fittings, etc., both through the introduction of new equipment and the improvement of existing equipment. "We also believe," he said, "that through proper organization and the use of multiple-purpose devices a more complete utilization of work equipment can be attained." He also hopes for the development of better ballast-cleaning equipment and of a machine for removing the ballast from the cribs; of a device which will remove "frozen" nuts from track bolts after rail is thrown out of the track; of a machine which will straighten and line tie plates; of some tool for setting and starting cut spikes straight, which will work rapidly enough to keep ahead of mechanical spike drivers; of pile-driver leads for steam hammers which can be folded back quickly against the boom to permit traveling and handling piles with the hoisting line without detaching the leads; and of inexpensive forced-feed oiling equipment for rail joints." Lem Adams, engineer maintenance of way, Union Pacific, said that "A highly desirable addition to our equipment, which to our knowledge has not yet been developed, would be a mechanical tie puller, that would remove the old ties from the track without disturbing the line."

Increased Utilization

Most of the officers in both of these groups called attention to the fact much of the equipment in use is not utilized to the fullest possible extent. They expressed the opinion that along with the development of new equipment and the improvement of that already available, equally intensive study should be given to getting the full measure of use from the equipment which they have.

As an indication of the view of those who believe that the railways are not getting the full measure of benefit that would be possible through more intensive use, F. R. Layng, chief engineer, Bessemer & Lake Erie, believes that "the greatest development of the future will be a more complete utilization of existing equipment. As a matter of course, there will be further refinements in what tools we now have, but I believe that the development of additional machines will come rather slowly."

C. H. Paris, chief engineer Illinois Midland does not look forward to the introduction of much new equipment in the next few years. "In my opinion it would be a mistake," he said, "to continue to flood the market with additional equipment until there has been a general awakening to the fact that there are still greater possibilities in the man-power to operate what we now have. We are confronted with the necessity for a more intensive, intelligent and thorough use of the equipment now available." That the same opinion is held by A. Montzheimer, chief engineer, Elgin, Joliet & Eastern, is evidenced by his statement that "the greatest development in the next few years will be the improvement of existing equipment and a more complete utilization of it." J. C. Patterson, chief engineer maintenance of way, Erie, is also of the opinion that "the greatest development will be a more complete utilization of equipment." Likewise, Mr. Adams looks forward "to a more complete utilization of existing equipment, supplemented by improvements that will be made in such equipment." A. E. Owen, chief engineer, Central of New Jersey, expects developments that "will include improvements in existing equipment, new devices and, more particularly, a better utilization of what we now have."

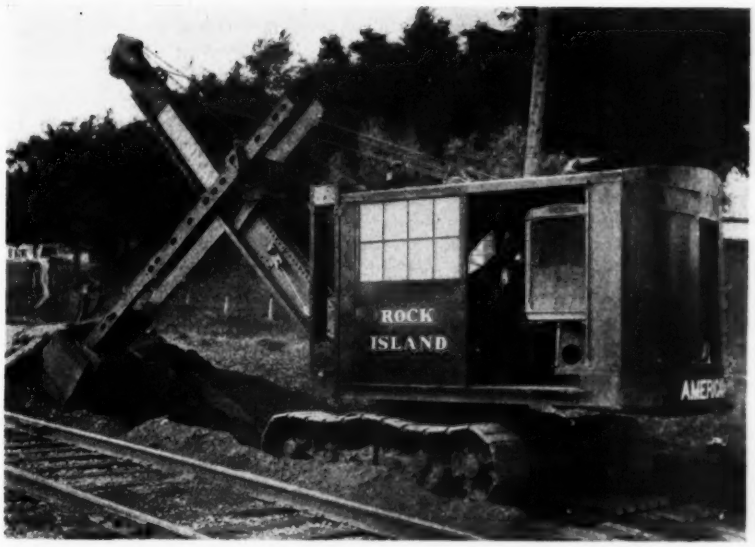
It is a surprising feature of the foregoing statements that none of them is the opinion of a single officer. On the contrary all of them were found in many replies. It is evident, therefore, that there is a general belief that further refinements are required in some types of equipment and that radical revisions should be made in the design of others. Furthermore, it is apparent that there is a definite need for still other machines that have not yet been designed or developed to the stage of demonstrated practicability.

Field Not Static

In other words, despite the fact that the mechanization of railway maintenance has progressed rapidly in recent years, the field is by no means static, and manufacturers can extend their market far beyond its present limits by studying railway needs and designing or improving their equipment to meet these needs. Furthermore, it is equally evident from the discussions which were contained in the replies, that the manufacturer who, having perfected a device, makes no effort to improve it in the light of accumlated experience or changing demands, cannot expect even to retain the market which he has built up over a period of years. In other words, he must be quickly responsive to new requirements or changing conditions and be prepared to meet them as they arise.

Probably no feature of the replies was so surprising as the unconscious reflection that was made on the sales methods of some of the equipment manufacturers. It is a startling fact that many of the officers to whom these queries were addressed are not aware that certain forms of work equipment are available. In reply to the questions on unmet needs, it was frequently stated that machines or tools for certain operations are needed, and that, if obtainable, they would be purchased in the belief that the use of equipment designed for these purposes would result in large savings.

The fact that the equipment so mentioned, and this mention was not confined to one or two types, is in use on other roads, puts the manufacturer on the defensive with respect to his sales methods, since it is apparent that the officers under discussion are openly receptive to suggestions relative to the use of such equipment. These facts confirm observation that the manufacturer who expects to be successful in the railway field must wage a continuous and persistent campaign of education to bring and keep his products before the widely scattered maintenance forces, so that these men will be informed as to the availability of this equipment and the increased economy and efficiency with which work may be conducted through its use.



An Example of a General-Service Machine

Should general-purpose appliances be preferred to machines designed to perform one task with maximum efficiency?

One Use Or Many?

TO BE worthy of purchase, a mechanical appliance must earn its keep. In other words, its use must result in savings in excess of what it costs to own and operate it. To get the right answer, therefore, it is necessary to consider not only the operating and maintenance costs involved but also the money that must be provided to meet the interest and depreciation charges. And as experience has shown that it is not always easy in maintenance of way work to keep a machine busy, it is natural that railway officers should have this requirement uppermost in mind when considering various devices that are offered for use in their work.

Believing that this consideration has a pertinent influence on the selection of equipment and that maintenance of way officers have given this matter a great deal of study in considering different classes and types of appliances, it was felt that an exchange of opinions would be of definite value to all who are confronted with the responsibility of recommending the purchase of mechanical equipment. To this end, therefore, the following question was submitted to the ranking maintenance of way officers of the leading railways of the United States and Canada.

Do you prefer equipment designed specifically for a certain task as contrasted with a more general utility device? In other words, when selecting equipment what weight do you give to possible secondary uses or to the versatility of a unit?

Versatility Simplifies Task

Answers to this question covered a wide range of opinions. It is evident also that those who addressed themselves to this specific phase of the problem of power devices did not all have the same general type of equipment in mind in preparing their answers. In general, however, it is obvious that with a machine which can be applied to a variety of uses, the problem of finding work for it at all seasons of the year is much simpler than is the case with a device that is designed and built to perform a specific task. This view was clearly set forth by A. C. MacKenzie, engineer maintenance of way of the Canadian Pacific, eastern lines.

"There is such a wide variety to maintenance of way work that a machine which can be applied to a number of uses is bound to be more popular and more valuable to the railway than one with but a single purpose. The overhead charges to the individual job are reduced as the machine is kept employed more continuously and there is also the added advantage that if the equipment has several uses it will probably be worn out before it becomes out of date."

Many Concur in This Opinion

Similar views were expressed by J. C. Patterson, chief engineer maintenance of way of the Erie; H. S. Clarke, engineer maintenance of way of the Delaware & Hudson; A. A. Miller, engineer maintenance of way of the Missouri Pacific; Robert Faries, assistant chief engineer maintenance of the Pennsylvania; J. L. Kirby, chief engineer maintenance of way of the Seaboard Air Line; B. A. Wood, chief engineer of the Mobile & Ohio; and W. S. Burnett, chief engineer of the Big Four. This view was expressed more specifically by W. H. Peterson, chief engineer of the Chicago, Rock Island & Pacific, who says, "Labor saving machines for track and other railroad maintenance work should be designed for use in more than one class of work to make it a general utility machine so far as practicable."

There are, of course, certain classes of equipment that lend themselves naturally to a wide variety of uses, foremost among which are such portable power units as gasoline engines, gasoline-engine-driven air compressors and engine-generator sets. These are applicable to any service demanding power conforming to the capacity range and energy characteristics which the particular unit is designed to provide. Other equipment in the same category includes locomotive cranes, small track cranes, crawler-mounted tractors, convertible ballast cars, etc. Besides these, also, are the so-called crane-shovel-dragline machines which have been introduced by a number of manufacturers during the last few years and which have demonstrated remarkable versatility. Another de-

velopment is the application of various accessories to crawler-mounted tractors that have had the effect of increasing their usefulness greatly.

The advantage of such versatility was stressed by A. Montzheimer, chief engineer of the Elgin, Joliet & Eastern. It was also touched on by W. H. Courtenay, chief engineer of the Louisville & Nashville, as follows, "It is a decided advantage to have equipment which can be used for more than one purpose—for instance, when compressors are not being used for tamping track they can be used for drilling rock, spray painting or other purposes. Cranes should be such as can be used in both the track and bridge departments, and it is frequently advantageous to help out other departments with them." F. R. Layng, chief engineer of the Bessemer & Lake Erie, prefers a combination crane and pile driver for this reason.

Of Advantage on the Small Road

General-service equipment is especially advantageous for the small road which, obviously, cannot have enough work of any one kind to keep a specialized machine busy. This point was brought out by W. G. Brown, engineer

To Be of Maximum Effectiveness, Some Equipment Must Be Designed to Perform One Specific Task

maintenance of way of the Florida East Coast, who says, "I prefer equipment that is adaptable to as many varieties of use as possible. In my opinion, on a small road such as this, where no one particular class of work ordinarily lasts the entire year, work equipment should be purchased so far as possible, with a view to versatility in operation so that many small and varied tasks might be accomplished, keeping the machine in constant use. On larger systems where each class of work is of such volume that the machine can be transferred from division to division and kept constantly in use on one particular operation, I would prefer equipment designed specifically for each task." Similar views were expressed by S. B. Clement, chief engineer of the Temiskaming & Northern Ontario and W. A. Spell, engineer maintenance of way of the Atlanta, Birmingham & Coast.

Officers of two railways feel that a distinction should be made between small equipment and large equipment because of the differences in the capital investment involved. "We prefer," says G. W. Harris, chief engineer, Atchison, Topeka & Santa Fe System, "equipment designed specifically for individual uses for the reason that the investment is small and it is available when wanted, thus allowing work to progress without relation to other maintenance items. However, a combination self-propelled machine could be used to advantage in the shaping, agitating and reworking of ballast, in the cleaning of track ditches and shaping of the roadbed."

This is also the opinion of C. H. Paris, chief engineer of the Chicago & Illinois Midland, who says, "For large equipment, I believe it is of greater advantage if the machine is capable of general rather than specific use."

Not All Are of the Same Opinion

It is not to be expected, however, that all men who must make decisions with respect to power equipment are of the same opinion, for, as clearly set forth by E. A. Craft, engineer maintenance of way of the Southern Pacific, Texas and Louisiana lines, "There is plenty of room for difference of opinion among officers of any one railroad as well as for a difference in the thought of different railroads as to the ultimate economy of using various kinds of labor-saving devices." This is borne out by the opinion expressed by A. O. Ridgway, chief engineer of the Denver & Rio Grande Western, which stands out in sharp contrast with some of those previously cited.

"Ordinarily," says Mr. Ridgway, "we prefer equipment designed specifically for a certain task in the confident belief that a work horse and a race horse cannot be found in the same animal. Generally, there is more ultimate economy in providing a device for a specific accomplishment."

Several engineering officers have given expression to much the same view. In the words of C. S. Robinson, engineer maintenance of way of the Maine Central, for example, "There are some tasks that demand a machine solely for the task in question and attempts to broaden its scope detract materially from its original value." H. R. Clarke, general inspector of permanent way, Chicago, Burlington & Quincy, is of much the same opinion. "We prefer equipment designed for certain tasks. On a road such as the Burlington, there is generally enough work for a unit of equipment in the particular task for which it is especially designed and we think that equipment of this kind is more efficient than if it were designed for a number of different tasks."

A. F. Blaess, chief engineer of the Illinois Central, expresses the same view when he says, "Ordinarily we prefer equipment designed especially for certain tasks. Of course, if a machine can be used for more than one service, it would be given preference over a machine confined to only one service, provided that the additional attachments do not interfere with the work for which the machine is primarily designed." Bernard Blum, chief engineer of the Northern Pacific, is more emphatic. "Considerable of our equipment, such as compressors, cranes, etc., can be used for more than one purpose and this point is given consideration in deciding upon types of equipment to be purchased. On the other hand, efficiency for a definite purpose should not be sacrificed in order to obtain vague promises of universal adaptability."

Greater Use Possible in the South

This view finds considerable support in the south, where climatic conditions favor year-round work so that proper scheduling permits of virtually constant operation of certain types of machines in a single class of work. J. E. Willoughby, chief engineer of the Atlantic Coast Line, reports as follows, "We prefer equipment of standard types and do not desire the type convertible to other uses because for each item of labor-saving equipment which we own, we have an amount of work sufficient to keep that equipment on the job for which it is

best adapted, throughout the twelve months of the year, except that used for destroying weeds and grass."

C. E. Weaver, assistant general manager and chief engineer of the Central of Georgia, says; "Equipment specifically designed for a certain task is best for the reason that if we have a machine that does a special job well, we get everything out of it that can be expected, whereas, if the machine is designed to do several jobs, it is not likely to do any of them particularly well."

Mr. Craft of the Southern Pacific also prefers special equipment where it can be kept at work in all seasons. G. H. Harris, chief engineer of the Michigan Central, "prefers special-duty machines, with some exceptions, such as tractors, convertible ballast cars, ballast spreaders, cranes, pneumatic hammers, etc."

On the northern roads, also, there are several officers who, while conceding the economic advantage of general-service machines in principle, are inclined to question the practical possibilities of such equipment in a considerable number of operations. The important point raised is the efficiency of any one machine as applied to a variety of operations. Thus, J. R. W. Davis, chief engineer of the Great Northern, says, "Equipment designed to handle more than one kind of work is preferred, so that the machines may be kept in service a larger number of days annually, providing the efficiency of the machines is not materially lowered through adapting them to more than one kind of work." The matter of efficiency is also stressed by W. S. Hanley, chief engineer of the St. Louis Southwestern.

How Long Can It Be Used?

Another line of approach to the problem is to consider the number of months in a year that a machine can be kept busy, regardless of whether it performs one task or many. Thus, G. A. Phillips, chief engineer of maintenance of the Lehigh Valley, says, "When we buy equipment we prefer to purchase devices that can be used the year round if possible, rather than seasonal. This, however, is not always possible." W. P. Wiltsee, chief engineer of the Norfolk & Western, also applies the test of the probable annual service period, but in a somewhat different way, when he says, "Equipment which is designed for a certain task is generally preferable where the particular task involved, such as ballast cleaning service, spreading and ditching work, etc., requires a working period of more than six months of the year."

But this is not always the criterion, for as pointed out by A. N. Reece, chief engineer of the Kansas City Southern, "The investment is profitable on some specialized equipment which is used only a few months during the year."

Difficult to Generalize

The differences in opinion expressed in the foregoing paragraphs arise primarily from the fact that it is difficult to generalize on a subject that embraces so many different classes of equipment. Air compressors and locomotive cranes, for example, are clearly general-service machines, while spike pullers, tie adzers and certain others which could be named are just as definitely special-service devices. Still others have a primary application but can also be applied to one or more secondary uses, while a few machines like portable weed burner-snow melters, are used for one purpose in summer and for another in winter. On the whole, however, according to E. L. Crugar, chief engineer of the Wabash, "Very few of the machines designed for track work or other maintenance of way work are versatile. Generally speaking, equipment has been purchased to perform specific tasks, although the possible use of a unit in other work has been given considerable weight."

This view is endorsed by the engineering officers of a considerable number of roads. For example, Mr. Clarke of the Burlington always considers the secondary uses of all equipment. "There are times," he adds, "when it is not or cannot be kept busy in the primary use. We base our decision, however, on the saving that can be effected in the primary or special use. The other uses and savings are incidental and in addition to those upon which we base our decision."

A specific example is offered in the statement of Lem Adams, engineer maintenance of way of the Union Pacific. "We are inclined to favor equipment designed for a specific task. However, some of the machines we have are readily adaptable for general work, such as the ballast discer, which was designed primarily to loosen up the ballast shoulder for the improvement of drainage. However, with proper attachments, we have used this machine very effectively for throwing out old ballast from the shoulder preparatory to reballasting, and found it very useful this winter for cleaning snow away from the ends of ties to improve drainage conditions." This latter thought is expressed as follows by Mr. Wiltsee of the Norfolk & Western, who says, "It occurs to me that in the purchase of rail-laying machines and miscel-

Various Accessories Serve to Increase the Versatility of Some Machines

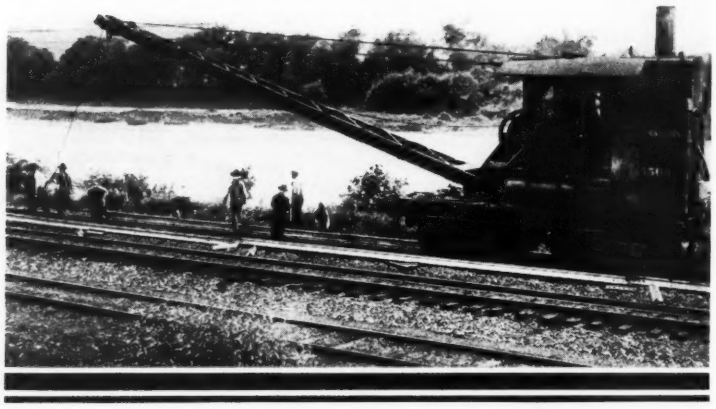
laneous types of gasoline-driven, tractor-mounted shovels the question of their secondary uses should be considered in order to keep them busy, if possible, the entire year."

Considerable weight is given also to secondary uses by P. C. Newbegin, chief engineer of the Bangor & Aroostook, F. R. Layng, chief engineer of the Bessemer & Lake Erie, F. S. Schwinn, assistant chief engineer, Gulf Coast Lines, and E. E. Oviatt, chief engineer of the New York, New Haven & Hartford.

Obviously, any machine that can be put to a variety of uses will have preference over a device that can be applied to only one task. However, it must be recognized that some tasks can be performed effectively only by an appliance that is designed especially for that purpose. It is also necessary to bear in mind that the practice of transferring a machine from one service to another has its limitations. Too often the two types of work are most advantageously performed during the same season, and in the opinion of several railway officers there is danger than an effort to effect greater versatility may result in reduced efficiency. In many cases, also, the answer to the problem of greater use of an appliance lies in better organization and scheduling rather than in application to a wider range of tasks.

Cutting E

By G. A. PHILLIPS
Chief Engineer of Maintenance,
Lehigh Valley



Relaying Rails With a Crane Is an Old Practice on the Lehigh Valley

PRESSED by the exigiences of present business conditions, the maintenance of way department of the Lehigh Valley has effected economies, the extent of which are particularly striking, in view of the fact that there has been little or no deferred maintenance on our road. Whereas total maintenance of way expenditures on the Lehigh Valley reached a peak of $9,176,529 in 1926, and were $8,310,466 in 1927, they were reduced consistently in each succeeding year until they amounted to only $5,925,266 in 1930 and $4,664,229 in 1931.

These large reductions reflect savings through a wide range of changed methods and practices, which, in turn, have reduced material purchases and man-hours employed. Possibly the largest share of the economies effected, due to many factors, has been in our reduced labor requirements. Whereas, for example, we employed more than 11,000,000 man-hours in current repairs in 1918 and 1920, and in excess of 8,000,000 man-hours in the five years immediately following 1920, our man-hour requirements have been reduced consistently since to the point where we employed only 4,882,300 man-hours on current repairs in 1930 and 3,687,895 man-hours on such repairs in 1931.

Economies Became Imperative

In order to remain solvent in the face of the large handicaps which have confronted the railways of the country in recent years, including not only the large decline in gross earnings due to business conditions, but also the necessity for assuming large additional burdens in the way of grade crossing eliminations and the installation of train control, it has become necessary for the roads to scrutinize expenditures carefully and to effect all possible savings without detriment to their properties through deferred maintenance. The Lehigh Valley has been no exception in this regard. Early in 1928 it became necessary for our road to make drastic reductions in expenses, owing, in part, to the falling off of anthracite coal tonnage. As a result, when the general business depression arrived, we had already had considerable experience in the art of reducing expenses and it was, therefore, only a matter of continuing to place our house in order, or, in other words, to "cut the cloth to fit." That we have done just that is evidenced by the figures already given. Yet in spite of the large reductions which have been made, the physical property of the Lehigh Valley is in good condition.

The question has been raised frequently as to how we have been able to effect these large economies while maintaining smooth-riding and safe track. This article is an attempt to answer this question, and is presented at some length, even at the expense of repeating certain details with regard to Lehigh Valley methods and practices which may be known quite generally.

The Lehigh Valley, with 1317 miles of lines, including approximately 500 miles of double-track main line, extends from New York to Buffalo, N. Y. The ways in which such large savings in maintenance of way expenditures have been effected on a road of this size and character make a long story and one which begins many years back. In other words, many of the economies effected during the last few years are the direct result of the continuation of certain long-established practices. It will be necessary, therefore, to explain a number of these general practices since a knowledge of them is vital to an understanding of the economies obtained. The greater portion of this article will however, deal with maintenance matters on the Lehigh Valley from January, 1928, to January, 1932.

Sources of Economy

Among the many factors which have had a bearing on the large economies effected on our road are the use of a good grade of stone ballast; proper surface and subdrainage; the preservation of ties and timbers; the use of a heavy track structure with 136-lb. rail and large tie plates; the discontinuation of the spacing of joint ties; the building-up of rail ends, frogs, switch points, etc., by welding; the extensive use of time and labor-saving equipment; the organization of special extra crews for out-of-face surfacing; the laying of rails during the winter months; the detouring of trains to minimize interruptions to rail laying or other major maintenance operations; the use of snow melting devices and modern plow equipment to minimize hand labor in the unproductive work of snow removal; the lengthening of track and signal sections; the use of commercial current for signal operation, doing away with batteries; and the systematic scheduling of maintenance of way work.

All main line tracks of the Lehigh Valley are ballasted

Expenses in Half In Five Years' Time

How the Lehigh Valley has reduced its maintenance of way expenditures $4,500,000 and man-hours 54 per cent, without deferred maintenance

with a good quality of stone, to an average depth of 14 in. under the ties. The stone used is of a size which will pass through a 3-in. ring and be retained on a 1¼-in. ring.

The cleaning of this ballast was a very expensive operation a few years ago. It was impossible to secure enough men to perform by hand all of the work of this character that was necessary, and it was financially impractical to attempt to do it in this manner. Furthermore, the magnitude of this problem was always a source of discouragement to maintenance officers and men, who, unable to cope with it successfully and economically, had to stand by and see the results of their efforts to maintain good track minimized by the adverse affect of dirty ballast.

Mechanical genius, however, has solved this problem. The cleaning of stone ballast in recent years has been performed by locomotive cranes with screening equipment, and by specially designed power ballast cleaners. We have used such equipment in the past, but during the season of 1931 we employed a new type of self-contained power ballast cleaner. With this machine we cleaned 200 miles of inter-track space, working one shift each day for 135 days, at an actual cost of 6¼ cents per foot, including all expenses, and lost no time on account of breakdowns of the machine.

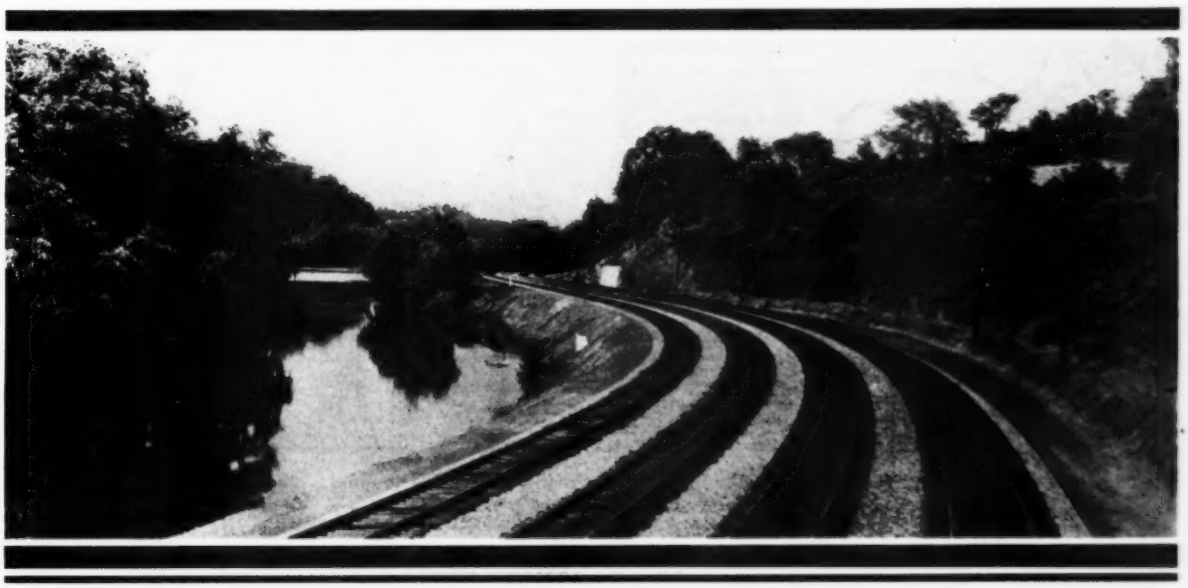
This was not only faster and cheaper than we have been able to clean ballast with cranes and screens, but it released for other important work the large number of cranes which had been tied up in the ballast cleaning operations. Our ballast cleaning troubles are over, therefore, because with the machine used in 1931 we can clean the entire stone ballast mileage on our road in two years, and at low cost.

Early Tie Treatment Shows Results

All crossties purchased by the Lehigh Valley for main line use since 1909 have been creosoted, and extensive use has also been made of treated switch timbers, lumber and piling. Oak ties are used largely in main line tracks, particularly on curves, although close-grain yellow pine ties, properly treated, have proved their worth on the lighter traffic portions of our line, particularly on tangents and when properly protected against mechanical wear.

The preservation of all of our timber is performed by the Federal Creosoting Company at its plant at Manville, N. J., under the direct supervision of the railroad. All ties, switch timbers, piling and lumber are purchased in quantity lots, based on our annual requirements, to secure the benefit of quantity prices, and are forwarded to the treating plant for proper seasoning and treatment.

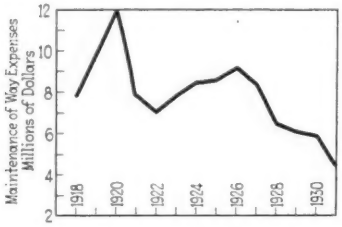
Careful purchase and rigid inspection of ties have been important factors in the long service life obtained from ties on our road. Our purchase specifications are designed to secure good quality, low priced timber, without sacrificing soundness and strength, and, to insure that these specifications are met, we have our own inspectors in the tie producing areas. These men, at



On the Four-Track Section of the Lehigh Valley Between Easton, Pa., and Bethlehem

times only one man, not only inspect the finished ties to insure that they comply with our specifications, but also move about in the timber cutting area to insure that the timber purchased was grown and produced under favorable conditions.

Our concern with regard to ties extends throughout their service life. Care is required in their handling; they are all adzed and bored before treatment; and the greatest care is exercised in determining which ties shall be removed from main line track. In this latter regard, it is our practice when surfacing and renewing ties, to remove all ties that will not stand up as long as the surface of the track, a period of three to four years, depending upon conditions. Foremen have been trained to the point where they are skilled in determining which ties should come out, but even their discretion is checked closely by our supervisors and division engineers who are continually going over their territories. Some of the ties removed are burned, but many others are relaid in yard and other less important tracks, where they have been found to give satisfactory service for a number of years.

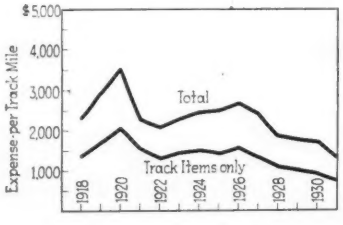


Maintenance of Way Expenses*

Tie Treatment and Distribution

That we have been successful in our purchases of ties and in securing long life from them is evident from the accompanying table, in which are given for the last 20 years the tie renewals per mile of track on the Lehigh Valley and on all other roads in the United States, combined. Figures showing the renewals on all roads for 1930 and 1931 are omitted since they were not available at this time.

In our early treatment of timber, we used straight creosote oil, but in later years we have been using a mixture of 7 per cent creosote and 30 per cent coal tar, which has given very satisfactory results, and at reduced cost. Treatment is done by the Lowry, or "empty cell process." In this process, as used on the Lehigh Valley, selected air-seasoned timber of the same species and density is run into the retort on cars. No initial air pressure is applied to the timber. The cylinder is first filled with creosote from the charging tanks, at a temperature of 200 deg. F., following which pressure is applied until the timber takes up a predetermined amount of the preservative. The pressure is then released and the surplus oil drained off, following which a strong, quick vacuum is produced in the cylinder to recover the free oil.

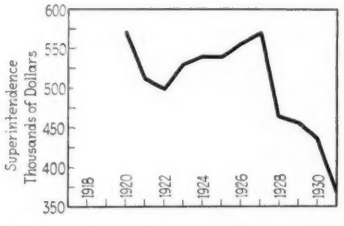


Expenses Per Track-Mile

We do not hold to any set rule with regard to the amount of preservative to be used. Most of our lumber, pine switch ties and oak crossties are treated to refusal. Pine crossties are treated for complete sap-wood penetration, and the amount of oil used in this process varies with the quantity of sap wood. Following this practice, we find that the average amount of preservative used is about equal to the amount called for in most specifications for thorough treatment, and by treating to refusal, we obtain a better distribution of the preservative in the wood. The statistics of tie renewals on the Lehigh Valley as given herewith seem to prove this contention.

Creosoted ties and switch timbers are shipped out and distributed on the right-of-way only as required for immediate use, the balance being stored at the treating plant where they can be loaded out in large quantities at small cost with cranes when necessary. This arrangement offers many advantages. It avoids unsightly piles of ties along the right-of-way; it eliminates the expense of unnecessary handling of the ties in the field and of protecting them against fire along the right-of-way; and it places the ties in small quantities along the track exactly where needed.

All ties, as ordered, are shipped in low-side cars. A track supervisor who has air tamping units in operation on his territory distributes them ahead of each gang, perhaps once a week, in connection with other work-train duties. One, and not more than two men, easily push the ties from the car while the work train is in motion. This makes it possible to distribute a maximum number of ties in a minimum of time and at minimum expense. Frequently, ties are unloaded in this manner by use of local freight trains or locomotive cranes, thus avoiding the use of work trains. Other methods of unloading ties have been used, including cranes with slings, but we have found that these methods are not as economical as our latest practice.



Officers and Clerks and Office Expenses

Average Crosstie Renewals Per Mile

Year	*Lehigh Valley*	*All Roads*
1910	177	239
1911	141	262
1912	164	257
1913	267	262
1914	232	256
1915	289	268
1916	286	253
1917	178	210
1918	173	200
1919	195	209
1920	116	210
1921	133	213
1922	77	203
1923	91	188
1924	109	184
1925	91	190
1926	82	183
1927	92	177
1928	56	181
1929	48	170
1930	58	...
1931	48	...

The extensive use of preservatives has also proved effective for the protection of switch timber, piling and lumber, and, combined with the long-standing practice of treating crossties, has been an important factor in the

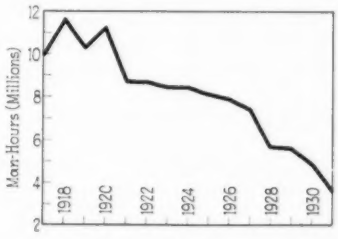
*The graphs presented on this and the following page show the large reductions in maintenance of way man-hours and expenses that have been effected on the Lehigh Valley.

reduction of maintenance expenses in recent years.

Just what our long-standing policy of treating ties and switch timbers, together with our care in handling and protecting them has meant to our road in reduced man-hours, is pointed out clearly in the report of the Committee on Economics of Railway Labor of the American Railway Engineering Association, to be presented before the annual convention of the association this year. In this report, a study of the man-hours saved through our reduction in tie renewals in 1929 as compared with the average renewals in 1915 to 1917, inclusive, places this reduction at 1,017,437 man-hours.

Drainage has also been considered a most important factor on our road in securing economically maintained track. Year after year we have carried out ditching operations with locomotive cranes and ditching machines, and, in addition, more than 90 miles of subdrainage has been installed. In this latter work, which covers all of the spots on the road which gave the greatest amount of trouble, drains were laid beneath one or both side ditches, and in the inter-track space if required, with lateral drains where necessary.

In the early work of this character, tile drain pipe was used, but in recent years, eight-inch perforated metal pipe has been employed. This pipe is usually laid in a trench with its base about four feet below the flow line of the side ditch, and the trench is then back-filled with one-man stone and covered over with cinders. Occasionally, under certain conditions, the pipe is placed closed to the ends of the ties and about 12 in. below them.



Current Repairs

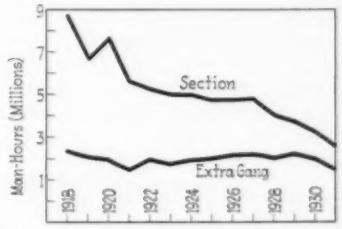
The use of heavy rail and large tie plates has also exerted a strong influence on maintenance costs on the Lehigh Valley. Prior to 1915, rails of 110-lb. section and less were used, but with steadily increasing speeds and wheel loads it was felt necessary to adopt a heavier section of rail. In giving consideration to this subject, it was decided to adopt a section which would meet our requirements for many years, if not for all time. Therefore, in 1915, a section weighing 136 lb. per yard was designed and adopted. This section of rail, which is 7 in. high, 6½ in. across the base, and has a moment of inertia of 86.5, was purchased exclusively by the Lehigh Valley until 1931. In that year, the original 136-lb. section was redesigned slightly to give it a height of 7⅜ in., a base width of 6½ in., and a moment of inertia of 98.5. As a result of this redesign, which did not affect the weight of the section or the width of its base, an increase of 14 per cent in the strength of the rail was secured, as well as ½ in. more fishing space for the joint bars.

Advantages of New Section

The newly designed section, with its increased girder strength, supports the heavy wheel loads with minimum deflection, thereby reducing wave motion in the track, which is recognized as the cause of much track maintenance expense. The adoption of this large rail section permitted us to increase its carbon content, thereby making it harder and more resistant to wear, particularly when laid on heavy curves, of which there are so many in the mountainous territory we traverse.

The rails, which were originally rolled in 33-ft. lengths, and in more recent years in 39-ft. lengths, are laid on heavy double-shoulder tie plates. These plates, which are 8 in. by 13½ in. in area, and canted 1 in 20, are spiked to the ties independent of the rail, and, therefore, are not disturbed in connection with normal rail renewals. The use of these large plates has had an important bearing on the tie life obtained on the Lehigh Valley, since they have reduced mechanical wear of the ties to a minimum. Furthermore, they have had a marked effect in holding the rails to gage, as is evidenced by the fact that it is rarely necessary to regage our track, in spite of the large number of sharp curves encountered.

During the last two years, as a further step toward economy, we have experimented with longer rails, and 10 miles of rails 66 ft. in length have been laid in our tracks. Every advantageous feature anticipated in connection with the use of these longer rails has been realized, and I would recommend without reservation, the exclusive purchase of these longer rails.

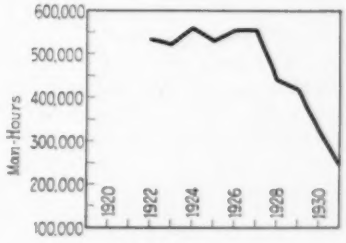


Section and Extra Gang Laborers

We also attempt to get the greatest possible wear from our rail on sharp curves through the use of rail oilers, and, at the present time, have about 125 such devices in service on various parts of our road. These have been operating with excellent results, and it can be said conservatively that the life of the rails on the high side of certain of our heaviest curves has been practically doubled through the use of the oiling machines.

In addition to the preservation of rails by the use of oilers, we have, for many years, been increasing the service life of rails on sharp curves by transposing them when they have received a certain percentage of wear. In other words, we have found that when the wear on the rails in curves reaches a certain point, it is both desirable and economical to move the low rails to the high side of the curve and the high rails to the low side.

We have found that rails could be left in the track as originally laid for several months after the time when it would be economical to transpose them, but that during this added time these low rails become so damaged that they cannot be used again in main tracks. If, however, transposition is made before the low rails become too badly damaged, large increased service life is obtained from them. For example, on a curve where the rail will last a year before being transposed, without the use of oilers, we will get approximately 15 months' service life out of it in its second installation after transposition, or a total life from the rail of 27 or 28 months. The increased life in the second installation is due to the case-hardening of the steel under the cold rolling action of traffic during the first installation.



Signal Forces

That all of these factors, beginning with the most important, the large section used, have had an important bearing on the large savings which have been effected by

the maintenance of way department, in both labor and material costs is demonstrated conclusively through the fact that, after allowing for reductions in traffic because of business conditions, there have still been large reductions in rail purchases, and thereby rail renewal labor costs, which can be accounted for only through the increased life which we are securing from our rail.

We have designed our track construction to make it as simple as possible because it is our feeling that simplicity makes for economy and improves the morale of our men. Our switch construction, for example, is designed to involve as few parts as possible, and includes a one-piece guard rail and heavy switch plates with rail braces welded directly to them. These features result in less noise and wear, and at the same time afford simpler maintenance. Manganese frogs are in general use on our road, with the self-guarded type employed in yards and slow speed tracks.

Rail Laying in Winter Is Economical

All rail is laid after the season of surfacing track, in so far as possible,—in most cases during November and December, even though it may be purchased and received early in the year on account of mill conditions. The only exception to this practice is when it might be found necessary, unexpectedly, to surface a piece of track that is to be relaid in the fall, in which case we lay the rail and then proceed with surfacing, but this occasion is rare.

It is necessary to maintain a small force of men on each section of track during the winter months to cope with such emergencies as snow storms and the formation of ice, as well as for carrying out other details of routine maintenance work which must be followed up in the winter as well as in the summer. However, every snow flake handled by these men unnecessarily means expense to the railroad for which no value is received.

It is essential that section men be employed on productive work during the winter and, with this in mind, we bring them together and lay rail. This practice enables us to confine our summer force to work which can not be performed during the winter months on account of climatic conditions, and, at the same time, secures for us a maximum return from our labor expenditures during the winter.

Power tools are used to a large extent in rail-laying operations, and we secure full use of the track when necessary, a factor which is most essential to economical performance and in which we have had the full co-operation of our operating department. Following this method, as many as five track miles of rails have been laid in a day with a force of approximately 125 men. The rail released in main line renewals affords us a sufficient quantity of satisfactory rail for use in branch lines, where it is laid in the same order as it is removed from the main track. This has enabled us to lay all of our new rail in main line tracks.

Another factor having a bearing on the condition of our roadway and our low maintenance expenditures, is the fact that for a period of years our tracks over the system have been strengthened by the widening of embankment shoulders and by affording rip-rap protection along streams and rivers where necessary. Work of the latter character has been carried out most extensively where our tracks parallel the Lehigh and Susquehanna rivers, between Easton, Pa., and Sayre, in which territory washouts were frequent, causing constant maintenance expense. In this territory, approximating 125 miles of rip-rapping was done during 1927, 1928 and 1929. The stone for this work was secured at Hazleton, Pa., where extensive stripping operations were under way, and was transported and deposited with 30-yd. air dump cars.

The Lehigh Valley has always been a believer in and a large user of power tools and equipment. If the use of specific equipment offered real economies we have not held back on its purchase. On the other hand, we have first made sure that the equipment would meet our requirements and would perform its functions more economically and satisfactorily than could be done with hand tools: In a number of cases we have been so desirous of securing certain devices or units of equipment which could not be found on the market, or that were not suited to our conditions, that we have constructed units of our own design to meet our needs.

Some of our most numerous units of equipment are power tie tampers, used in our surfacing work during the summer. Power surfacing has been found more economical than pick tamping, and insures a higher and more uniform quality of work. Three or four tie tamping outfits are usually assigned to each subdivision, which continue in uninterrupted operation throughout the working season, without interference with traffic or the routine work of the regular section forces.

In connection with our surfacing work, it is interesting to note that we do not respace ties and have not done so for the last 20 years. This in itself has been a most important factor in the reduction of labor expense, and we believe that it has proved also of great benefit in maintaining smooth-riding track.

Central Repair Shop Affords Economies

Recognizing that the profitable use of power equipment is dependent largely upon its being maintained in first class condition, all such equipment, incuding tie tampers, motor cars, power drills, etc., is overhauled, rebuilt and kept in repair at a maintenance of way shop at Weatherly, Pa., which is centrally located on the road. This shop is fitted with the latest equipment for such gas engine work as the reboring of cylinders, the refitting of pistons and piston rings and the grinding of valves and valve seats. Prior to the establishment of this shop, equipment repairs were handled by a divisional organization, which employed 20 men. The central shop, which was established in 1928, has employed only 3 men in this class of work, with 5 mechanics in the field, but now even these field men have been found unnecessary.

In many phases of our work we have eliminated the so-called specialists and have required our regular forces to handle most of the miscellaneous work with which they may be confronted. It was in line with this policy that the field repairmen were dropped. Our present arrangement not only reduces the force required on this work, but has also resulted in the reclamation of more material and a higher class of work.

A large part of our frog and crossing repair work has been handled out on the line with portable welding apparatus, but some of it has been done in the maintenance shop at Weatherly. The reforming of angle bars and the general repair and reclamation of track tools are also done at this point, this latter work including the overhauling of air tamping guns, which are put in first class condition and tested for economical air consumption. It takes more than "noise" to tamp ties, and we have learned that unless the guns are tested occasionally, the results secured with them will not be the most effective. Many other classes of work, including the salvaging of frog and switch material, are also done at the shop with economy.

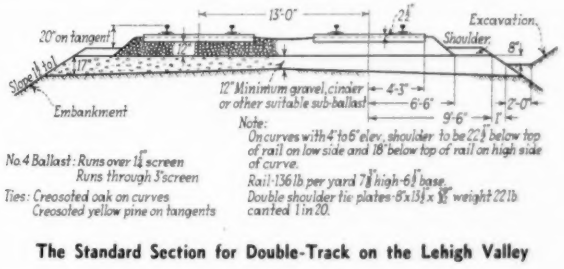
Some of the largest economies which have been

effected on our road are reflected in our method of handling routine maintenance work and by the lengthened sections which have been established during the last couple of years. All of our work is carefully programed in advance, from the standpoint of the road as a whole as well as the divisions and subdivisions. In fact, even our foremen are required to map out their work so that there is a minimum of lost motion among their men.

Section Forces Reduced

Our section forces are maintained small the year around and at a minimum during the winter, most of our heavier work being done by specially organized gangs. Careful consideration was given some time ago to the question of the lengthening of sections, and, as a result, since 1928, we have reduced the number of our sections nearly one half, from 302 to 160, with an average outlying double-track section including nine miles of double track. Such a section normally has a force of four men in the summer and not more than two men in the winter.

With the lengthening of sections has come an appreciable reduction in the total number of man-hours worked on each section. This is evidenced by the fact that whereas a total of approximately 4,000,000 section labor man-hours were worked on both current repairs and new work on the Lehigh Valley in 1928, only about 2,500,000 section labor man-hours were worked in 1931. That



The Standard Section for Double-Track on the Lehigh Valley

this reduction has not been effected by increases in the number of man-hours worked in extra gangs, is shown by the fact that extra gang labor man-hours have also been reduced consistently from a total of approximately 2,200,000 in 1929, to approximately 1,150,000 in 1931.

Through the consolidation of sections we have not only saved man-hours, but we have reduced the stocks of tools and equipment ordinarily furnished to section gangs, regardless of their size, and also the number of motor cars in operation.

In line with the economies made through the increased length of sections, careful thought was also given to the old-fashioned trackwalker with his wrench and dinner pail, and sometimes umbrella, in hand. As a result, trackwalking was abolished, substituting motor patrol where necessary, and requiring every gang and supervisory officer moving over the road to be watchful of conditions. The elimination of unnecessary patroling of track, in combination with the lengthening of sections, has resulted in an annual saving of approximately $550,000 in labor alone.

The substitution of commercial current and rectifiers in 1928 for primary batteries in our signal circuits enabled us also to lengthen our signal sections, with the result that whereas we formerly had 70 signal sections, we now have only 26. This readjustment has saved us $200,000 annually, of which $96,000 was in labor. Rectifiers also replaced batteries in the telegraph department, resulting in an additional saving, not included in the figures above. Over a period of years we have also been gradually replacing the motorized signal with the position-light type of signal, which has also effected some economies.

Notwithstanding the reductions in force effected, it is noteworthy and almost astonishing that the per cent of signal failures and the amount of punitive overtime are considerably less than before the reorganization took place, even after equating the figures to account for fewer operations due to reduced traffic.

All buildings, tracks and structures have been removed where not required, thereby avoiding maintenance expense and releasing material for use elsewhere. This work has been carried to the extent that it is estimated that approximately 300 buildings of different types have been abandoned and removed during recent years.

In our wide search for sources of economy, careful scrutiny has been made of overhead expenses, taking into consideration the class of employees under the Interstate Commerce Commission's classification account, "Superintendence". As a result, operating divisions have been combined where possible, resulting in savings of $300,000 a year in maintenance of way since 1928.

Many Other Factors Contribute

Many other savings have been effected through changes in practices, which while perhaps not particularly impressive by themselves have in the aggregate resulted in economies of considerable magnitude. For example, through the more careful programing and execution of work, the number of work-train days for current repairs on our road has been reduced materially. In fact, we made a reduction of 37 per cent in work-train days during 1931 as compared with 1928, which, of course, effected a considerable saving.

Switch lamps have been eliminated on all tracks equipped with automatic signals, as have also switch stand targets and many switch lamps in yards, particularly in floodlighted areas. This has resulted in so many lamps being on hand, that additional purchases will be avoided for some time. The substitution for the old wooden roadway signs of metal signs with the lettering cut out in a manner similar to a stencil, has materially reduced sign painting and maintenance. In fact, it is estimated that the saving effected in this account alone amounts to approximately $10,000 a year on our road.

Crossing gates have been replaced with automatic flashing light signals where possible which has reduced both the expense of crossing attendants and the continual cost of gate maintenance and repair. Similarly, economies have been effected through the use of better and more economical grade crossing paving materials. All plank crossings have been supplanted by oil and stone mixtures or other modern materials, with satisfactory results for the public and economies in maintenance.

Derails, particularly if pipe-connected to switch stands and installed on facing point switches, are a source of maintenance and they have, therefore, been removed wherever possible. Our scale department was reorganized and two men now handle all scale maintenance and repairs on the system in a satisfactory manner. Acetylene, electric and Thermit welding are being used on a large scale in track work, as already mentioned, extending the life of our track materials and structures with considerable saving.

In former years, labor camps were handled by outside contractors at considerable expense to the railroad. Two years ago, their operation was taken over by the maintenance of way department, a change which has not only improved living and culinary conditions at the camps, but which has eliminated all expense to this company.

Careful consideration has been given to the consolida-

tion of all electric power purchases to secure the benefit of the lower rate on large current consumption. In this connection, particularly at important points along the line, all electric power purchased is routed through a single meter in so far as possible.

Large economies have also been effected in our bridge and building department. This department, like the track department, has been provided with modern machinery and power tools to facilitate its work and to effect all possible economies. Properly equipped shops are provided where similar shops in the mechanical department are not available. Careful attention is given to the design of structures and to the methods employed in the field. Wherever possible, small timber structures for waterways are replaced by pipe to afford permanent construction and to reduce maintenance. Where timber cattle passes must be replaced, large concrete culverts are substituted. If the span is not too great, these culverts are precast on the site or at some central point and are installed with cranes. Where the span is too great, we must, of course, construct the culverts in place under traffic.

To reduce the cost of renewals, extensive use has been made of creosoted lumber and timber in the construction and maintenance of permanent structures, and, on branch lines, solid-deck creosoted timber trestles, supported on pile bents, have been used to a large extent. These structures not only stand up over a longer span of years, but they also minimize the work of the section forces in maintaining run-offs at each end. Considerable attention has also been given to the use of electric and gas welding in bridge repair and strengthening, solely with the aim of facilitating this class of work and of effecting economies.

All of the foregoing practices or measures mentioned have contributed toward the large savings which has been made in maintenance of way expenses of the Lehigh Valley in recent years. The extent of these savings, and, therefore, the combined effect of the policies and methods adopted, are shown clearly in the following table of maintenance of way expenses and current repair man-hours on the Lehigh Valley for the last seven years:

	Total M. of W. Expenses	*Man-Hours Current Repair Only*
1925	$8,574,787	8,104,051
1926	9,176,529	7,894,186
1927	8,310,466	7,426,245
1928	6,428,685	5,675,413
1929	6,110,455	5,590,042
1930	5,925,266	4,822,300
1931	4,664,229	3,687,895

No Deferred Maintenance

The Interstate Commerce Commission's accounts No. 202 and 220, Roadway Maintenance and Track Laying and Surfacing, comprise an important part of maintenance of way expenses. An analysis of these accounts shows that, on the Lehigh Valley, they have been reduced by $1,400,000 since 1927, equivalent to 52 per cent.

At first glance, the reduction in total maintenance expenses from $8,310,466 in 1927, and over $6,000,000 in 1928 and 1929, to only approximately $4,665,000 in 1931, might seem to indicate considerable deferred maintenance on our road. This is not the case, since our property has been maintained to a high standard and was in good physical condition at the close of 1931. Maintenance of way expenses have struck a new level, and while future years, with increased traffic, may necessitate additional expenses, any such increases will be slight in comparison with the increase in revenue.

As a matter of interest in connection with the subject under consideration, a table is given in the next column in which are set forth the last four-year averages of the ratio of maintenance of way expenses to gross earnings for representative roads in various districts of United States, as well as the same ratio for all roads, this four-year average being taken as more representative of normal maintenance than the comparison for a single year on account of the possible drastic reductions representing deferred maintenance on some roads in 1931. The statement shows the Lehigh Valley with a low average ratio. While in a sense comparative figures do not always give the exact facts they do present a certain yard-stick of measure and also indicate that there must be some merit in the practices and ideas which we have put into effect.

Maintenance of Way Expenses—Per Cent of Operating Revenues Average for Calendar Years 1928-1931, Inclusive

Lehigh Valley	9.09
Delaware, Lackawanna & Western	9.64
Pittsburgh & Lake Erie	11.60
Erie	12.10
New York Central	12.83
Delaware & Hudson	13.19
Central Railroad of New Jersey	9.83
Chicago, Indianapolis & Louisville	10.24
Baltimore & Ohio	10.89
Chicago & Eastern Illinois	11.75
Pennsylvania	12.40
Long Island	11.63
Reading	14.27
Union Pacific	12.58
Chicago, Burlington & Quincy	14.53
Atchison, Topeka & Santa Fe	15.56
New York, New Haven & Hartford	14.00
Boston & Maine	16.66
Northern Pacific	12.46
Chicago & North Western	14.96
Kansas City Southern	11.40
Illinois Central	12.44
Seaboard Air Line	13.62
Southern	14.75
Atlantic Coast Line	14.90
Louisville & Nashville	15.36
Virginian	9.89
Norfolk & Western	12.81
Chesapeake & Ohio	13.43
All Roads—United States	13.38

There is nothing mysterious about maintenance of way work. There are many tangible and intangible ways of affecting maintenance of way costs, but one of the most important factors is the application of "common sense," which will go a long way toward accomplishing the desired results. Many men are adept at telling how things can not be accomplished, but it is the fellow who says "can," who should be on your payroll.

Further Economies Possible in Future

Human nature is a great study, and it is only through a complete understanding of it that the greatest results can be accomplished where dealings between men are required. Co-operation is most essential in any organized effort, and maintenance of way work is no exception. Much depends upon the loyal support and enterprise of each man, and with this in mind, subordinate officers should be given definite responsibilities and allowed to "use their own heads." The results will be of benefit to the organization as a whole, to higher officers and to the men themselves. The railroads are not going to stand still. The future holds forth many changes in methods and materials, and economies far beyond those which may have been effected to the present time. It behooves no one, therefore, to fall into the non-progressive class and get the idea that he is "caught up."

An Old-Time Section Gang and an Old-Time Motor Car. Is One as Obsolete as the Other?

What of the Organization?

Does the use of power equipment point to the need for a redistribution of forces for the performance of maintenance of way work?

EVERY maintenance officer who has had his ears to the ground during the last few years knows that the maintenance of way organization is in a state of flux. The spirit of change is in the air. It is true that only a few railways have made drastic revisions as yet, but it is also true that many roads are subjecting their present systems of organization to keen scrutiny, while there is almost no railway that has not made some change—at least to the extent of introducing practices that have decreased the amount of work done by the section forces.

While this movement is still in its infancy, and there are those who depreciate its importance, there is good reason for the feeling that it is fraught with far reaching consequences. It is significant that this movement for a change in organization represents the first important departure from the established order of things in 100 years experience in railroading. Some 20 years ago, when the track motor car was introduced, a few railways lengthened their sections on the ground that the faster-moving car enabled the gang to cover its territory with sufficiently greater facility to warrant such a change. But this movement proved sporadic; the time was not ripe for it. However the two decades that have passed since that time have wrought profound changes, some of which have effected an automatic redistribution of maintenance work while others are giving rise to revisions of practice which are resulting in a re-allocation of duties and other administrative changes.

Foremost among the changes, and the one which has resulted in a steady though imperceptible change, is the greater strength and stability in the track structure as a consequence of improvements that include everything from better drainage of the roadbed to a marked increase in the weight of rail. This has resulted in a pronounced decrease in the expenditure for upkeep as contrasted with major renewals. The use of treated ties adequately protected by tie plates, for example, has effected a pronounced reduction in one item of section work—the renewal of crossties.

Of no less importance is the mechanization of maintenance work, which has given rise to critical study of prevailing plans of organization with a view to securing a more intensive use of the various appliances that are now available. In view of the drastic revolution in industry that followed the introduction of machinery, it is to be expected that the organization that was built up for the maintenance of roadway and structures on the railways with hand implements is not necessarily adapted to obtaining the most effective and efficient results with power appliances. As stated above, rather drastic changes have already been made on certain railways and it is to be expected that others will follow. In an effort, therefore, to learn what various railways are doing along this line and to ascertain the prevailing thought on this subject, the following question was placed before the chief engineers or engineers maintenance of way of a considerable number of representative railways of North America.

To what extent is your use of labor saving equipment leading to or indicating the advisability of changing or modifying your organization of forces to secure full advantage from the equipment? In what ways have you made such changes or are considering such changes?

Much of what follows is based on the replies received, although not a little has been drawn from material concerning the practice of individual roads which has been presented in detail in articles previously published in *Railway Engineering and Maintenance*.

Replies were received from the officers of 40 railways and while this number is not large enough to permit of comparisons on a percentage basis, the mileage represented is sufficient to afford a fair index of trends. That the tendency toward change in organization is by no

means general is indicated by the fact that 14 of the railways from whom reports were received have made no definite change, contemplate no change and see no particular need for modification of existing forms of organization for maintenance of way work. Only five offered any definite reason for this position. One reported an insufficient complement of power equipment to exert any influence. J. E. Willoughby, chief engineer of the Atlantic Coast Line declared that "the labor saving equipment which we have has been bought to fit the existing organization, and has not been bought with the idea of changing the organization." P. C. Newbegin, chief engineer of the Bangor & Aroostook, points to the particular conditions presented in a territory of severe winters. "Winter conditions, where motor cars cannot always be run on account of snow, restrict the length of sections and apparently make our present organization of the maintenance of way force necessary."

The point raised by G. H. Harris, chief engineer of the Michigan Central, that "The section foremen and their men know their territory and how best to get results," was voiced emphatically by a number of speakers at the convention of the Roadmasters' Association in 1930, in opposition to appreciable changes in current forms of organization. E. D. Swift, engineer maintenance of way of the Belt Railway of Chicago, pointed to the particular problem of the terminal property where multiplicity of switches and other special work demands a well distributed section force to insure adequate and frequent inspection.

Longer Sections

Fourteen of the replies report an increase in the dengths of sections, with corresponding reductions in the number of section gangs. Two ascribe the changes specifically to the taking over of work by special maintenance gangs, and three cite the influence of motor cars in permitting the more rapid movement of the gangs as the chief influence. While section forces have been reduced generally as a consequence of the retrenchment of the last two years, five of the replies make a point of the reduction in the size of section gangs. The report from one road, on the other hand, refers to larger section gangs.

With respect to extra gangs, the number of comments were fewer, four reporting smaller gangs and eight mentioning the employment of larger gangs as a current tendency, special assignment to a single class of work and operations extending over several divisions or an entire system being an essential feature of the large gang idea in most cases. Replies from five railway officers offered no distinctive plans of reorganization but stressed the necessity of adjusting the gang organization to meet the requirements of effective work by the machines and the influence of the local conditions. A number also gave expression to the thought that the general subject of organization to fit modern equipment is one demanding thorough study. Thus we have the words of C. S. Robinson, engineer maintenance of way of the Maine Central, "Our purchase of labor saving equipment is rapidly reaching the point where our present organization must be changed to handle it efficiently."

Why Less Work Is Done by Section Gangs

What are, therefore, the outstanding changes to date? The most definite answer can be given with respect to section work, which has been reduced generally by a smaller labor allowance per gang or by increasing the length of sections without a corresponding increase in the number of men per gang. This has been brought about in part by the reduced maintenance requirements resulting from marked physical improvement of the track and roadway. But it is due also to the fact that certain tasks are no longer performed by section gangs because the work can be performed better and cheaper by other means. Weeds are destroyed by chemical application or burning, and the track fastenings or the entire superstructure is oiled mechanically with equipment that moves from division to division. The same plan applies on a smaller scale to ballast cleaning and on at least one road to power bolt tightening. Ditching and the application of subsurface drains have long since ceased to be a responsibility of the section forces.

These changes have all taken place so gradually that their effect in reducing the volume of section work may easily be discounted unless particular attention is directed to it. As an example of this tendency, C. E. Weaver, assistant general manager and chief engineer of the Central of Georgia writes as follows: "During the past season the weed burners were started out in June, followed by the mowing machines and later by the discers. Subsequently, the burners cover the lines again to insure as clean a track as possible. The operators of these machines are competent roadway men who keep their machines in repair at all times. It is our practice to use two men as a crew and these men take care of all three machines assigned them. In our section of the country the use of these machines is necessary about nine months during the year."

Of more recent effect and less general application is the deliberate transfer of many operations that have always been considered the province of the section gang to what, for want of a better term, is now designated variously as the division maintenance gang, supervisor's gang or floating maintenance gang. Exponents of this plan have insisted on some other name than "extra gang" since its work is not to be confused with the tasks ordinarily performed by gangs so designated. Rather, the work of the maintenance gang is confined to tie renewals, lining and gaging, and out-of-face surfacing of the kind that is done in the interval between regular ballasting operations. The manner in which this plan has been carried out on the Great Northern and the Chicago, Milwaukee, St. Paul & Pacific, and extent and nature of the reduction in section forces effected, were set forth in detail in an article that appeared in the issue for March, 1930, page 119.

Practice on the Boston & Maine

A variation of this plan has been applied on the Boston & Maine to heavy traffic main lines of heavy construction, while on light traffic branch lines summer section forces have been virtually abandoned in favor of a floating gang organization that does all the work except patrolling by a section foreman and one man who look after the section after the floating gang has moved on. The Missouri Pacific pursues a plan that is much on the same order. In all these plans, the floating gang is drawn from the division section allowance and its operation can be justified only as it can show economies over the performance under the plan previously in vogue.

A variation of this general plan was described by C. H. Paris, chief engineer of the Chicago & Illinois Midland, who shows how it may be applied to a road of limited mileage. "Our use of labor saving equipment," he says, "has indicated the possibility and economy of smaller section forces and the concentration of heavy work in the hands of special crews equipped with necessary tools and equipment. Therefore, for the past two

years our section forces have consisted of a foreman and one man throughout the 12 months. These small crews handle their own tie renewals, the crews doubling up occasionally for light surfacing or lining, but most of the season's surfacing and lining is being done by special crews equipped with electric tampers and living in boarding outfits. These special crews sometimes stop to do necessary construction work, such as the building of spur tracks, small rail renewals, etc. We contemplate extending the lengths of these two-man sections, thus employing fewer crews and requiring fewer motor cars." E. E. Oviatt, chief engineer of the New York, New Haven & Hartford, reports a reduction in section work by specially organized gangs provided with mechanical equipment.

The subject of section gangs cannot be dismissed without mention of the plan adopted by the Chicago, Burlington & Quincy, which has incorporated with a general lengthening of sections, a system of more intensive supervision that relieves the section foreman of responsibility for track patrol. This was explained in detail in an article by H. R. Clarke, published in the January issue, page 39.

A Significant Observation

The exigencies of the current depression have compelled the railways to limit the section forces to a skeleton organization, in many cases to a foreman and one man, for a period so long that it undoubtedly constitutes a record in railway history, and much to the surprise of railway officers generally, this has not resulted in a serious lowering of maintenance standards. Will this have a permanent influence on established policies with respect to the section organization? Who can say? Lem Adams, engineer maintenance of way, Union Pacific System, offers the following rather contradictory comment. "So far, we have not found that the section force as a general maintenance unit can be improved upon, but during the present stress of necessity we have learned that a very satisfactory track can be maintained with a much smaller assigned force than we had thought possible two years ago." It is of interest to note also that the Union Pacific has relieved its section foremen of the inspection of the track in automatic signal territory by assigning this task to signal maintainers.

The conduct of extra-gang work has been subject to much more drastic revision than section gang work. This is to be expected because much of the power equipment is better adapted to use by gangs engaged in major operations requiring a force larger than that normally provided for work on an individual section. It is axiomatic that the greatest return on the investment in appliances will be realized if only enough outfits are provided to equip a minimum number of groups and if these gangs are kept at work continuously for as many months each year as possible.

But this is not the only requirement, for those roads which have made the most intensive use of power tools and machines soon learned that the problems of organization and training of operators were more complex than had been encountered in the conduct of such operations as ballasting and rail laying by manual methods. A high degree of co-ordination must be developed because delay in any one unit of the operation has the effect of delaying the other units, with the result that some expensive piece of equipment will not be allowed to develop its full productive capacity.

Confronted with such difficulties, a gang employing power tools does not immediately develop maximum efficiency, but increases its productive capacity from week to week as the season advances. Faced with this fact, certain railways early realized the waste entailed in confining the activity of a well-trained gang to a single subdivision or division or of transferring a subdivision gang from ballasting to rail laying in order to keep it under the jurisdiction of the one roadmaster. This, then, was the genesis of the district, regional or system gang, that moves from division to division as the season's work is carried out, although other influences have been brought to bear in the development of this form of organization.

System gangs are both the reason for and the effect of other practices leading to greater economy in major maintenance operations. In other words, this development has run concurrently with other improvements. While the introduction of power tools can not be given credit for the practice of releasing a track for maintenance work on multiple-track lines, it has had a pronounced influence in its extension on many roads, for the fact that the suspension of work to let a train by was resulting in the idleness of expensive equipment was obviously a potent argument for keeping trains off the track on which work was in progress. Furthermore, the greater speed made by mechanized gangs working without interference with trains has pointed not only to the wisdom of keeping trains out of their way, but also to the continuation of the work of the gang beyond the limits of the division.

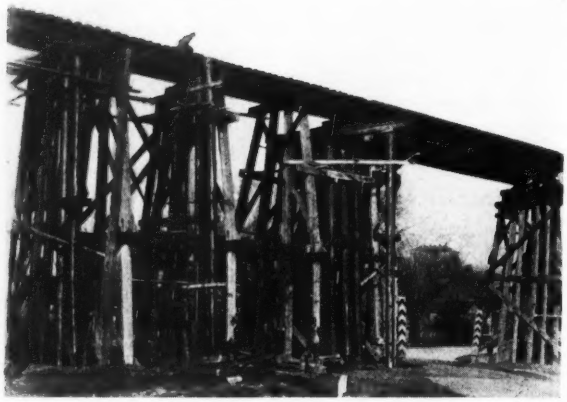
Bridge and Building Work

It must not be inferred from the foregoing that improvements in organization have been confined to the forces engaged in track work. That the greatest advance has been made in the work of the track forces is no doubt true and this is to be expected because of the far greater progress made in the mechanization of track work. Nevertheless, there has also been a well defined trend toward greater co-ordination and scheduling of bridge and building work and to perhaps a lesser extent in water-service maintenance.

One of the outstanding reorganizations of bridge maintenance work is that carried out by the Chicago, Milwaukee, St. Paul & Pacific, an exposition of which was published in the issue of June, 1931, page 544. Similarly, the handling of painting by a floating camp-car gang on the Pennsylvania was featured in the October, 1931 issue, page 894. The practice of the Chicago, Burlington & Quincy in covering work in all branches of maintenance has been reviewed by H. R. Clarke, general inspector of permanent way, as follows: "Our use of equipment with steel gangs within the last few years has caused us to program our rail-laying work in such a way that it is done with a smaller number of gangs and, if possible, these are kept constantly at work. The same applies to bridge work. Pile driving is scheduled for the system and the drivers assigned. Heavy bridge work is programmed in the same way, gangs are alloted and the equipment needed for the gangs, such as drills, power tools, etc., is assigned according to a thoroughly developed schedule. We have not made much change in our ballasting gang organization. Gangs for jobs such as construction have always been organized to fit the conditions under which they work and this is still true."

The statement of E. A. Craft, engineer maintenance of way of the Southern Pacific lines in Louisiana and Texas, covers the practice on his road. "The employment of labor-saving equipment inevitably leads to the organization of special working units to handle certain kinds of work—thus getting the maximum benefit out

(Continued on page 212)



Power Tools Were Used for all Sawing and Boring Required in the Renewal of this Bridge

Modernizing Bridge Maintenance Methods

Chicago, Burlington & Quincy demonstrates the economies to be effected by the use of cranes and mechanical tools in trestle renewals and other work

SOME time ago the Chicago, Burlington & Quincy was confronted with the job of constructing a new turntable circle wall for the engine terminal at Denver, Colo. Owing to the proximity of the roundhouse, it was necessary to work in very close quarters, and it was decided to employ a small self-propelled full-revolving crane of 7½ tons capacity on a 10-ft. radius. The new machine was fast in operation and was small enough so that it could readily be used while backed into one of the stalls of the roundhouse, and proved equally adaptable to a wide variety of uses. It was employed with a ½-yd. clamshell bucket to make the excavation, loading the spoil into cars which it moved on and off the turntable with its own power; it handled the forms in sections; it was employed to fill the aggregate bin over the mixer while concreting was in progress; and as each section of wall was completed, it was used to place the falsework to carry the track over the space between the new and old walls.

Many Applications

This serves to illustrate several of the many applications which the Burlington's bridge forces have found for power equipment in bridge work. Attention has been given mainly to the development of a complement of power equipment for the regular division gangs that are concerned primarily with the renewal of wooden pile trestles. The case cited above may be classed under the heading of supplemental uses of the small cranes by the bridge forces, since the cranes were brought primarily for the purpose of dealing with the last stronghold of heavy hand labor in railway maintenance, namely, the arduous work of handling the caps, stringers, ties, and guard rails of wooden bridges.

Several years ago, experimental use was made of a rail crane of the fixed-body swinging-boom type, and this machine produced a saving of $27.12 in the operation of removing the old stringers and placing the new ones in an eight-panel open-deck trestle. However, owing to the fact that this crane was of such limited capacity that it could handle only one stringer at a time, it was felt that better results could be accomplished with a larger crane, equipped for full-circle swinging. Accordingly, two new full-revolving cranes were bought for this service in 1930 and two more were procured early in 1931.

Experience with the new machines has indicated that they are better suited to the work. They can handle a complete chord of stringers (under one rail) as a unit, are fast enough to make the run to passing tracks to clear trains without excessive loss of time, and have many uses in addition to the handling of bridge timbers. They are used with a half-yard clamshell bucket for the excavation needed when a new end bent comes behind an old one, and for the filling required where the new end bent is located in front of the old one. They are employed also for loading and unloading material and equipment, thereby often saving the expense of work trains and the time of local freight trains where the latter have been employed in such service.

Machines of this type have been used also in moving cars of material out on a bridge. This was done by the Burlington in building the substructure for a new bridge across the Illinois river at La Salle, Ill. In addition, the crane was employed to unload sheet piling, support the leads for a sheet-pile hammer, handle the timbers for the cofferdams and lower concrete buckets into the caissons for the bridge piers.

Portable Hoists Also Used

There are places, however, where rail-truck mounted hoisting equipment cannot be used, as for instance, in handling timber for highway overcrossings. Experience has shown that two types of portable hoists are particularly adaptable for such situations. One of them is

operated by a gasoline engine and the other by an air motor. The Burlington now has four of the former type, two purchased in 1930 and two in 1931. They have two drums, 14 to 16 in. in diameter, connected through clutches to an integrally mounted four-cylinder gasoline engine and capable of a 5000-lb. single-line pull. The other type of machine is a four-cylinder Ingersoll-Rand utility air hoist capable of a 1400-lb. single-line pull which has been used to marked advantage in hoisting new structural steel used in the reinforcing of metal bridges. The hoist takes little space and is readily used for such work with the aid of a snatch block secured to a bridge member. The larger machines are of sufficient capacity to be used for handling a drop hammer for driving foundation piles with a land driver in locations not accessible from a track. Both types of machines are more economical in fuel consumption than steam hoisting engines.

Power Tools Prove Useful

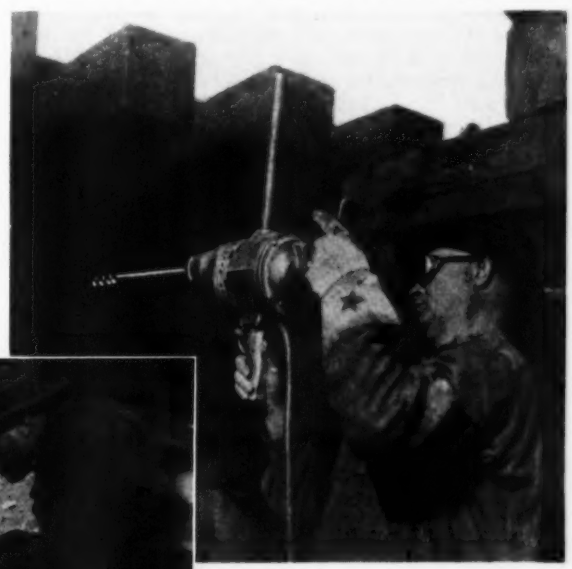
Provision for power hoisting solves only one of the problems of greater economy in bridge work, for until recently it was only in steel bridge erection that power tools have had any considerable application. The Burlington, however, has found that three types of power woodworking tools are of marked usefulness in bridge work, namely, the chain link saw for cutting large timbers and piles, the power drill, and the hand-held circular saw for use in cutting timber up to four inches in thickness. All three of these types of equipment have been employed in both electric and air-driven units, and steps are being taken to extend their use gradually among bridge and building gangs. The electric tools are somewhat more convenient to handle, but the air tools, particularly the Wolf chain link saws, have proved of advantage in working under water, as in cases where pile cutoffs must be made a foot or two below the water surface. They also have the advantage that compressed air may be made available for them by air compressors previously acquired for other uses.

Accordingly, the Burlington bought some air tools of these types, and later decided to make some test installations of electric tools with the necessary power units. Because it was felt that a gang provided with these tools should also be equipped with a small self-propelled crane, the question was raised as to whether air compressors or electric generators should be mounted on the crane, as this would make it possible to use the gasoline engine on the crane to supply the power. However, upon careful study, it was decided not to do this, not only because of the conclusion that the use of the crane in such added service would interfere with the effectiveness in the work for which it is primarily intended, but also because the need for moving the crane to a passing track to clear trains would necessarily remove the power supply from the tools at frequent intervals. For these reasons, the Burlington employs independent power units, except for one mounted on a crane.

Character of Power Units

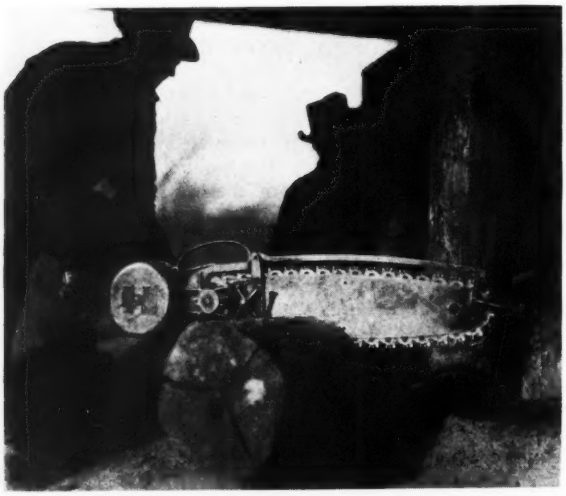
The pneumatic units are gasoline-engine compressor sets having a capacity of 250 cu. ft. of free air per minute. They weigh 7,200 lb. complete with the flanged-wheel truck on which they are mounted. Air hose of ¾ in. diameter is supplied for the chain link saws and ½-in. hose for the hand saws and drills. Hose leads as long as 400 ft. have been used in some cases.

The first electric power units, which were purchased about three years ago, consist of four-cylinder four-cycle Universal gasoline engines direct-connected to alternating current Root generators delivering 220-volt, 60-cycle 3-phase current and having a capacity of 7½ kv.a. The engine and generator have a common base mounted on skids and weigh 860 lb. complete. Eye bolts are provided for the insertion of pipe handles for lifting. These machines are provided with four receptacles for extension-cord plugs, two for 220-volt current, three phase, and two for 220-volt current, single phase, the former being provided for the link saw and the latter for small saws, drills, or, if desired, electric lighting.



Power Tools Increase the Output of the Men With a Much Smaller Expenditure of Effort

Three of these electric outfits were assigned to bridge gangs on lines involving a considerable amount of open-deck pile-trestle renewal, two on the Burlington proper and one on the Colorado & Southern. The gangs were also provided with self-propelled rail cranes. The advantage of using the power crane was appreciated at once by the men in the gangs, but they did not take an equal interest in the power tools until they had become thoroughly accustomed to them, in other words, until they had learned to handle them so as to avoid fatigue. Having acquired the necessary skill, they began to realize how much easier it is to saw off a pile or to drill bolt holes with these tools than with hand tools.



The Chain-Link Saw Is Readily Operated by One Man

Some Test Comparisons

In tests made with the Wolf electric saw at a time when the men had had only limited experience in handling it, eight old oak piles were cut off in 16 min. or an average time of 2 min. each, ten treated cypress piles were cut off in 15 min. or 90 sec. each and twelve 9-in. by 24-in. treated fir stringers were cut off in 20 min. or 100 sec. each. The piles in a six-pile bent were cut off in line with a straight edge guide in less than 8 min., while it would have taken two men approximately 1 hr. and 10 min. to cut off these piles with a cross cut saw.

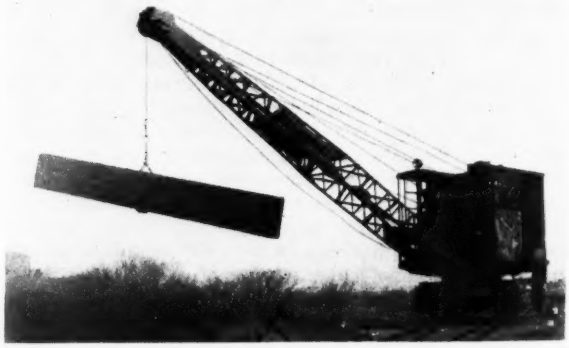
In tests with an electric wood-boring machine, a hole 13/16 in. in diameter hole was drilled through a treated cypress pile 15 in. in diameter and a 4-in. sway brace in one minute, compared with 5 min. 40 sec. with a hand augur. In another case, involving a 14-in pile, the time was 55 sec. for the electric drill and 5 min., 5 sec. for the hand augur.

The small hand-held circular saws are not used regularly in trestle-renewal work except for the occasional cutting of a brace plank. They have, however, proved very useful in other work done by bridge and building gangs and the savings that they effect on work for which they are suited justify the cost of providing them as regular equipment for the gangs.

The combined effect of the rail cranes and power tools in open-deck trestle renewals has been readily shown by the performance of the gangs. The regular bridge gangs engaged in such work on the Burlington consist of a foreman and from 10 to 12 men, of whom one-half are carpenters, one-fourth carpenter helpers and one-fourth laborers. Gangs equipped with power tools and a crane, and consisting of a foreman and six to eight men, will complete an equal footage of trestle renewals in the same time as larger gangs that are not provided with power equipment.

New uses for the equipment are constantly being devised. Thus to drill holes for the drift bolts connecting the caps to the piles of new bents, it is necessary to shift the stringers sidewise five or six inches on the old caps. This was formerly done by placing a jack in a horizontal position between the chords on top of the old cap and using it to force the two chords apart. By holding one chord in place by means of a track spike driven into the cap against the outside stringer, the other chord could be moved the required amount, and vice versa.

The full revolving crane has been used to do this shifting in an ingenious manner. A chain sling hung on the fall line hook is let down between the ties over the bent, one end of the sling being passed down each side of the cap and the two ends fastened so that the sling loops around the outside of the batter pile or the end of the cap. With the sling in this inclined position, the hoisting of the fall line causes the stringers to be pulled to one side. In this manner 28 sets of stringers have been moved sidewise by the crane and six men in four hours, whereas it takes six men about two days to do the same work with a jack.



Machines Like This Simplify the Handling of Trestle Timbers

The cranes are also used to advantage in placing sway bracing on pile bents, avoiding the laborious process of getting these braces into position with hand lines, and then holding them in place with spikes until the holes are drilled and the bolts are placed and drawn up. Instead, the planks are lowered to the ground first, after which the fall line of the crane is lowered between the stringer chords and a hitch taken near the center of the brace. It is then lifted and while being supported in this manner, is lashed in place with ropes while the holes are bored. This method involves less labor and avoids cutting into the creosoted wood with the temporary spikes.

Wrecking of old pile bents is also facilitated. The bent is supported by a line from the crane while the power saw is used to cut off the piles, and after this operation is completed, the crane line is easily handled so as to swing the bent over on its side. Two men with the power saw, together with the crane and operator, have wrecked 10 bents in this manner in 4 hours.

Avoid Employment of Additional Men

At one bridge the work included the renewal of the pile piers for a 90-ft. girder span, in addition to the renewal of the trestle approaches. These piers contain large and heavy timbers that could not have been handled by the

gang on the job without additional men if a crane had not been available. The crane proved useful in handling the heavy jacks and blocking employed in shifting the span longitudinally from the old to the new piers and in wrecking the old piers.

Following is a statement of the labor cost of building five-pile trestle bents with a crane and a pneumatic saw and drill.

	Machines		*By Hand*	
Place 4 caps.....	35 min.	$ 1.32	2 hr. 55 min.	$ 6.62
Cut off 20 piles....	50 min.	1.89	1 hr. 35 min.	3.59
Placing, boring and bolting up sway braces .....5 hr.	25 min.	12.29	6 hr. 50 min.	15.51
Boring and placing 5 fender timbers ..	35 min.	1.32	2 hr. 10 min.	4.91
(Two carpenters, two helpers) Total		$16.82		$30.63

Based on the performance record of the gangs that have been using the power appliances in this work, it is estimated that these tools are producing a saving of $1.25 to $1.50 per foot of trestle. The three sets of electric power plants and tools have now been in use for three years with practically no maintenance expense, although it is expected, of course, that a certain amount of overhauling will be required as the equipment gets older.

The success that has attended the use of this equipment has been responsible for the purchase of three additional gas-electric engine generator sets with the complement of tools, and two more of the self-propelled cranes. The new generators are 10-kv.a. capacity in place of 7½-kv.a. because the larger size is a standard one,

Unloading the Compressor—an Incidental Job for the Crane

whereas the smaller ones were of special construction. Furthermore, the larger size affords a reserve capacity that insures a greater factor of safety against overload. These machines can supply power to one chain saw, two drills and two hand saws simultaneously.

Used in Tunnel-Lining Work

While these outfits have been used primarily on trestle renewals they have been employed to advantage on other structures and to a minor extent on building construction. An interesting application was made some time ago in renewing some of the sets in the timber lining of a tunnel. The power unit is small enough to be set clear of the track between the side-wall posts and furnish current for electric light, as well as to the saws employed in framing the posts and arch segments.

The Burlington has also found use for other equipment in bridge and building work. A portable table saw driven by a belt from a drive wheel on a gasoline engine or an electric motor, has proved advantageous when there is considerable sawing to do, as in building forms for large concrete or tunnel work. A wood-working machine with a cut-off saw, rip saw and other accessories, is a valuable machine for building work. Portable gas-electric welding outfits are also now in use for repairing and strengthening bridge members in the field.

Portable gas-driven trench pumps are used to remove water from excavations for the smaller types of structures while portable gas-engine driven self-priming centrifugal pumps are the most modern up-to-date equipment in use on the larger construction jobs. These pumps are equipped with pump impellers of the open type and will handle water containing sand, mud or gravel without trouble. The most important feature is the automatic primer and it is no longer necessary to waste time in efforts to prime the pump.

While it is clear from the foregoing that the Burlington is away to a fair start in the application of power tools in its bridge work, the officers of the bridge department are impressed with the thought that it is but a beginning—that there is opportunity to do much more, not only in the equipping of a larger proportion of the gangs with power equipment but also in extending the application of the tools to further uses, as well as in effecting further adjustment in the methods of conducting various classes of work so as to use the machines to the best advantage. By way of illustration, it has been customary to unload bridge timbers at the ends of bridges and use the self-propelled crane to haul them out on the bridge for erection, as well as to haul in the released material to be piled on the approaches, whence it is loaded out after the job is finished. As this means that a large part of the working time of the crane is occupied in these transportation movements, it is proposed to make a thorough test of the idea of distributing the material on the ground

The Electric Generator and Three Electrically Operated Tools

along the length of the trestle, from which position it will be picked up by the crane as the renewal work progresses, the old timbers being deposited on the ground as they are released and later loaded directly in cars. It is estimated that in 60 to 70 per cent of all cases, the conditions are such that this method involves no hazard of the loss of material by reason of high water or floods and that there are many structures of moderate height where the time lost in hoisting from the ground would not be great.

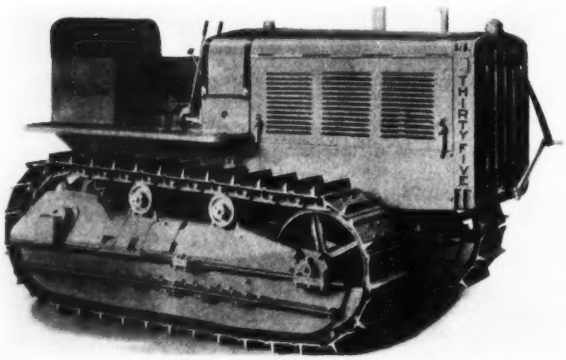
The application of power equipment in bridge work on the Burlington has been developed by F. H. Cramer, assistant bridge engineer, under the direction of G. A. Haggander, bridge engineer.

New and Improved Devices

Caterpillar Thirty-Five Tractor

A NEW model, known as the Thirty-five, has been added to the line of tractors manufactured by the Caterpillar Tractor Company, Peoria, Ill. In size and capacity this model lies between the Thirty and Fifty tractors, the latter also having been developed recently.

In appearance, general design and in many details the new model closely resembles the Fifty tractor. It develops a maximum drawbar horsepower of 37 and a maximum belt horsepower of 41. Four speeds forward



The Caterpillar Thirty-five Tractor

and one in reverse are incorporated in the new machine, which, in miles per hour, are as follows: First, 1.7; second, 2.5; third, 3.2; fourth, 4.6; and reverse, 1.7. It has an overall width of 72⅛ in., an overall length of 139⅜ in., and a height, exclusive of exhaust, intake pipes and canopy tops, of 69¼ in. The gage from center to center of the tracks is 53 in., the length of the tracks on the ground is 71⅜ in., and the area of ground contact with standard track shoes is 1,999 sq. in. The track shoes are 14 in. wide and the grousers are 2 in. high.

The engine is of the four-cylinder four-cycle, water-cooled type, with a bore of 4⅞ in., a stroke of 6½ in. and a governed speed of 850 r.p.m. The fuel tank capacity is 50 gal. Power is transmitted from the engine through a dry-type flywheel clutch to a change-speed gear set of the selective type.

It is expected that deliveries of the new model will begin in the early spring.

Fairmont Extinguisher Car Raises Weed Burner Mileage

FAIRMONT Railway Motors, Inc., Fairmont, Minn., has developed a fire extinguisher car for preventing the spreading of incipient blazes arising during the operation of track weed burners. The car consists of a 500-gal. electrically-welded tank in which a pressure of between 75 and 100 lb. is maintained by a 5-hp. Fairmont engine, both the tank and the engine being mounted on a four-wheel trailer which is towed by a motor car. The water is discharged through hose and nozzles which emit a 1/16-in. stream under constant pressure maintained by a rotary pump regulated by a governor. When all the nozzles are closed, the stream flows back into the tank through a by-pass and relief valve.

Under ordinary conditions the car is operated by three men—a motor-car operator and two hose men. Since the burner and extinguisher car travel at a speed of only 3 to 5 miles an hour, the motor-car operator may handle the long-range nozzle which is on a 50-ft. hose. The jets handled by the hose men, who sit on opposite sides of the motor car or trailer, have an effective range of 25 ft. with 10-ft. lengths of hose. Within these limits, the jets may be regulated to any distance desired. No water flows except when a nozzle finger lever is pressed and held down—a spring closes the valve when the finger lever is released. The water tank is equipped with a large hopper to facilitate filling, which may be accomplished at any roadside water column or tank.

The Fairmont 1932 Model Extinguishing Car for Weed Burners

The quenching capacity of the unit may be increased considerably by adding two hose men and two nozzles. An additional trailer carrying a 500-gal. tank and equipped with a platform and seat and a safety rail at the rear may also be supplied. A doubled water supply and four nozzles, however, have been found desirable only in forest areas during periods of drought.

During the late summer of 1931, one of these cars was operated in conjunction with a weed burner in dry forest territory where it entirely prevented fires from spreading off the right-of-way. On another railroad the cost of operating the extinguisher car plus the section labor required was said to average 50 cents a mile, while the cost of putting out fires on a third road, on which no extinguisher car was used, amounted to about $4 a mile.

New Surface Grinder Has Wider Range of Application

ONE of the most recent developments in power tools for track work, made by the Nordberg Manufacturing Company, Milwaukee, Wis., is a surface grinder which is intended primarily for use in grindng the running surface of rail ends that have been reconditioned by welding. This machine, which weighs 500 lb., is equipped with a four-horsepower engine for driving the grinding wheels. It can, however, be supplied with a seven-horsepower engine, which increases the weight to 550 lb.

Power is taken through a belt drive to operate the 10-in. by 1½-in. grinding wheel at speeds varying from 4,500 to 6,000 r.p.m. This wheel, which is of the high-abrasive type with a bakelite bond, has a transverse movement of 7 in. and a vertical travel sufficient to wear the diameter down to 5 in. This vertical travel is sufficient to permit grinding the side of the rail head to its full depth. The engine is controlled by a variable-speed governor which can be set manually to give any desired speed to the grinding wheel between the limits mentioned, so that a constant rim speed can be maintained as the grinder wears away.

The Grinding Wheel Runs at Speeds up to 6,000 r.p.m.

Through another power take-off, a flexible shaft can be applied, so that the machine can also be used as a cross grinder when desired. In this service it can be used in the same manner and for the same wide range of work as the lighter cross grinder which is described elsewhere in these columns.

In normal service, this machine can grind from 70 to 100 joints in an eight-hour day, depending on the amount of metal used in welding. It is said that two roads that have used it were able to increase the output of the welding gangs 33⅓ per cent per gas-welding unit, as compared with the output obtained when finishing the joints by means of peening hammers and flatters.

Dragline Booms Now Made of Aluminum Alloy

THE Bucyrus-Erie Company, South Milwaukee, Wis., has developed an aluminum alloy boom for draglines, which it is offering for any size of machine. Early last year this company constructed a 75-ft. aluminum alloy boom for a dragline with a 1½-cu. yd. bucket, which was placed in regular service at an anthracite stripping operation. In the following months of constant and vigorous use it is reported that the boom proved entirely satisfactory in all respects.

A Dragline Equipped With an Aluminum Alloy Boom

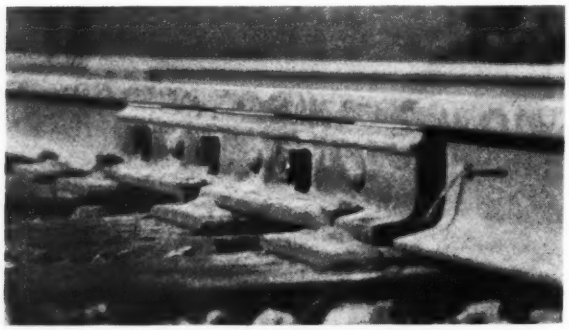
The outstanding feature of the boom is its light weight, which is only two-thirds that of a steel boom. This makes it possible to use longer booms with standard bucket sizes or to use standard boom lengths with larger buckets. This type of boom has been applied to several installations up to 175 ft. in length, in each of which it is said that it has proved its advantage.

New Flexible Rail Joint

THE Rail Joint Company, New York, has developed and placed on the market a flexible rail joint which has demonstrated a number of advantageous features in rail joint construction, without sacrifice of strength or economy, during the course of a service test of more than 5½ years. As a consequence of the features incorporated in the joint, it is claimed that the normal wave motion in the rail is closely approximated throughout the length of the joint, that there is greater freedom for rail expansion and contraction, that rail batter is reduced, and that there is less tendency for the joint bolts to loosen.

The new joint, which is called the Flexible Rail Joint, consists of six-hole joint bars, which have a smaller fishing height than usual to allow six metal shims or wear plates to be interposed between the bars and the rail. These wear plates, which are designed to fit the contour of the rail along the under side of the head, down the web and over the upper face of the base, are six and eight inches long, the six-inch shims being used at the ends of the bars and the eight-inch shims being applied directly across the joint. Thus, in a 38-in. 6-hole joint, the bars have a 6-in. bearing at each end and an 8-in. bearing in the center, with sections 9 in. long between the

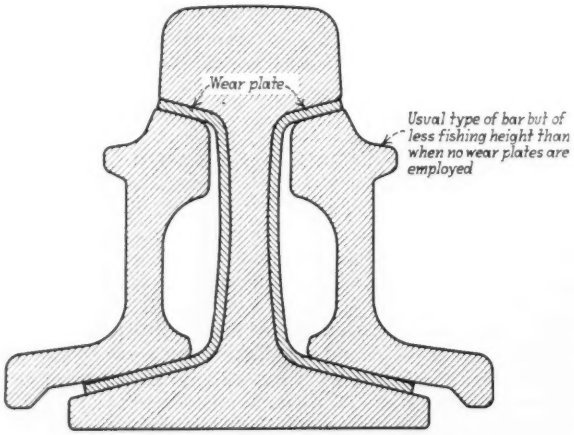
wear plates which do not come in contact with the rail. The wear plates are made of a somewhat milder steel than that used in the joint bars, and those which have been used thus far in the flexible joints have been ⅛ or 3/16 in. thick, the thickness depending upon the height of fishing of the bars relative to that of the rail. In each



One of the Flexible Joints in Service, Showing the Three Wear Plates Between the Rail and Joint Bar Head

case the plates are secured against lateral motion by the joint bolts, the end plates being held by bolts one and six, respectively, and the center plates by bolts three and four.

Through the intermittent bearing of the bars, it is claimed that in spite of tolerances in rail and joint manufacture, positive bearing is secured between the contact parts of the joint and the rail. At the same time, it is claimed that the provision of non-contacting areas between the center and end wear plates permits the bars to flex or yield under load, bringing about conditions within the joint area more or less similar to that throughout the unbroken length of the rail. Through this latter feature, it is said that much of the bending stress which is concentrated directly at the rail ends and applied suddenly in ordinary or continuous contact bars, is distributed throughout the bars of the flexible joint, thus



Sketch Section of the Flexible Joint Assembly

relieving them of the excessive wear and abuse which occurs ordinarily at the center of continuous contact bars, at times causing them to crack at this point.

Extended tests of the flexible joints in direct comparison with joints employing continuous contact bars shows that there was approximately 45 per cent less rail batter in the line of rails having the flexible joints and that considerably fewer loose bolts were found in these joints. This latter condition is explained partly by the reduced hammer or impact in the flexible joints, and partly by the lateral spring action which is set up in the bars by the tightening of bolts two and five, where the bars are not in contact with the rail. The tests also showed that the flexible joint was as strong as the continuous contact joint, and furthermore, that it permitted much greater freedom for the normal expansion and contraction of the rails due to temperature changes.

Other factors demonstrated by the tests were that all wear in the joints occurred on the top and bottom faces of the wear plates, and to the greatest extent on the center plates directly at the rail ends, with little or none in the rail fishing or in the bars themselves. Thus, it is claimed that the life of the bars is greatly extended through the necessity of renewing only the wear plates when reapplying the bars on new or worn rail.

A Smaller "Crescent" Tape-Rule

THE Lufkin Rule Company, Saginaw, Mich., has recently brought out a new tape-rule, known as the Crescent Junior, which is similar to this company's Crescent tape-rule except that it is smaller and lighter. The Crescent Junior, which also embodies an automatic wind feature with push-button operation, is made in 4-ft. and 6-ft. lengths. The blade is 7/16 in. wide and can be projected unsupported like a rule. It will also measure circles and odd shapes accurately.

The Junior Crescent Tape-Rule

The rule is made of tempered steel, stiffened by special forming, and has a dark background with markings in sharp contrast. It is graduated in inches and sixteenths with the zero graduation coming at the inside face of a hook at the end of the tape, thus allowing measurements that are out of reach to be taken conveniently. The case, which is 1¾ in. in diameter, is chromium plated and has round edges.

Wedge Blocks Speed Power Jack Operation in Ballasting

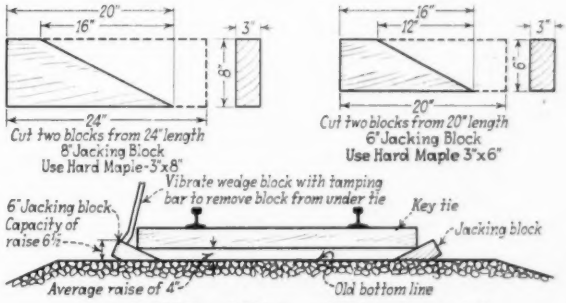
TO RETAIN the track at the proper elevation when raising with the Nordberg power jack and at the same time eliminate the necessity of tamping the key ties by hand, the Nordberg Manufacturing Company, Milwaukee, Wis., has designed a wedge jacking block for insertion under the tie after the track has been lifted.

As the track is raised, one man, or two at most, can slip the blocks under the key ties, thus eliminating the momentary delay while the ties are being tamped by hand and thereby releasing the power jack more quickly for the succeeding lift. In addition to the greater amount of track that can be raised by this method, it is claimed that there are other advantages in the use of these blocks.

Four chuckers normally accompany the power jack to "catch" the key ties and hold the lift. Through the use of the blocks, two, and often three, of these men can be released for other work. Since the blocks rest on the old bed there is no settlement, and because of their wedge shape, adjustments can be made in the surface by driving them in or out slightly as required. It is claimed that the use of these blocks insures more uniform tamping since the key ties are tamped with mechanical tampers

in the same manner as the intermediate ones.

Two sizes of blocks are recommended, one to be cut without waste from a piece 3 in. by 6 in. by 20 in. and the other from a piece 3 in. by 8 in. by 24 in. The former will care for lifts up to 6½ in. and the latter for lifts up to 8½ in. Hard maple provides the best wood for these



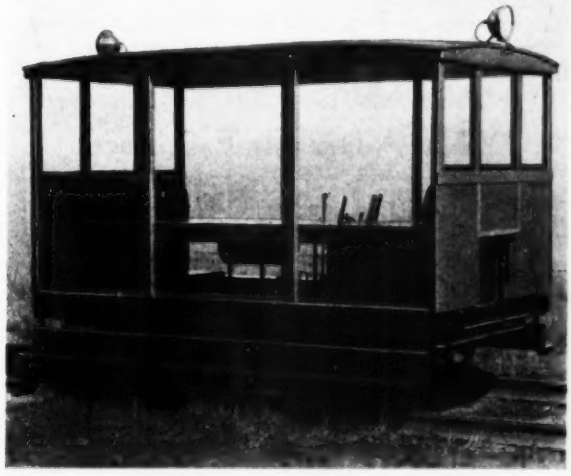
Blocks Hold Lifts of 6½ in. and 8½ in. Respectively

blocks, and is comparatively cheap. From 600 to 800 blocks can be cut from 1,000 ft. b.m.

Several hundred blocks will be required for a large ballasting operation. They should be distributed well in advance of the jack, one being placed on each side of the track at every point of raise. After use, they are quickly and easily removed by the tamping gang and can be carried forward for redistribution.

New Motor Car for Extra Gang and Hump Yard Service

THE Kalamazoo Railway Supply Company, Kalamazoo, Mich., has brought out a new enclosed motor car which is designed particularly for hump and extra-gang service and is known as Model No. 391. The chassis of the car, which will seat 28 men, is that of the



The Kalamazoo No. 391 Motor Car

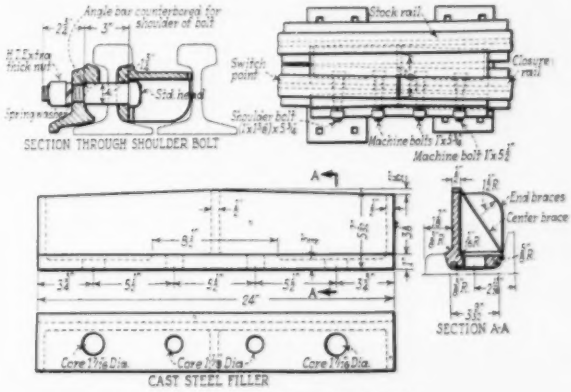
standard Kalamazoo No. 38 and is powered with a standard Model A Ford engine.

The car is equipped with a permanent top and is protected at both the front and rear with three glass windows, all of which, except the center front pane, can be lowered into plymetal panels. The sides are designed so that they can be enclosed with roll curtains, there being three curtains to each side. Ample visibility is provided by two large celluloid windows in each curtain. When not in use, the curtains are rolled up and fastened to the top of the car in such a manner that they can easily be dropped and fastened in place.

Switch Heel Block of New Design

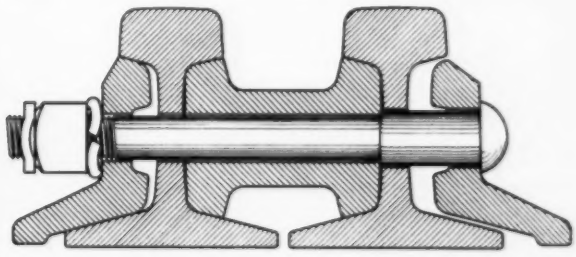
THE Pettibone-Mulliken Company, Chicago, has designed a switch heel block in which the bolts do not extend through the stock rail, thereby eliminating difficulties caused by the creeping of the rails. This block is also designed to serve as a foot guard, and is provided with a shoulder bolt of new design which obviates the need for using a pipe thimble to permit free hinge motion of the switch point.

The heel block consists of a steel casting 24 in. long, shaped in the form of an angle and reinforced with



Details of the New Heel Block

three ½-in. ribs, one at each end and the other at the middle. The vertical leg, which is ¾ in. thick and is provided with four bolt holes, is shaped to fit against the fishing surfaces of the switch rail and the adjoining rail, while the horizontal leg, which is ½ in. thick and 5⅞₂ in. wide at the middle, bears against the web of the stock rail. Thus the block serves the triple purpose of a splice bar, a foot guard and a separator.



Drawing of a Heel Block Assembly with a Shoulder Bolt Passing Through the Stock Rail

The bolt in the heel block nearest the switch point is provided with a shoulder in such a way that the joint bar and heel block can be drawn up tight without interfering with the free hinge motion of the switch rail. This shoulder is formed by giving the shaft of the bolt a diameter of 1⅜ in. for a length of 3 in. from its head, the remainder of the bolt being 1 in. in diameter. When applied, the head of the bolt is between the switch and

stock rails so that when the nut is tightened the shoulder prevents the joint bar from coming in contact with the rail. The inside of the joint bar is counterbored to provide an even bearing for the shoulder of the bolt. A shoulder bolt has also been developed for use where the bolts extend entirely through the heel block and the stock rail, as shown in one of the drawings.

Nordberg Develops Cross Grinder

TO MEET the requirements of the steadily growing practice of slotting rail ends, the Nordberg Manufacturing Company, Milwaukee, Wis., has developed a self-contained one-man cross grinder. This machine runs on one rail by means of flanged rollers, while an insulated supporting bar reaches to the opposite rail to provide stability. Although strongly built to withstand rough usage, the machine weighs only 300 lb. The free-running rollers are designed to minimize the effort necessary to propel the machine along the track as the work progresses. Because of its light weight, two men can easily lift it off the track, using the carrying handles provided for this purpose. Heavy hoop guards are also provided to permit almost instant removal without damage in case of emergency.

In operation, the grinding wheel is held freely in the hand, thus making it possible to grind gaps of any width, or to turn the wheel at any angle, so that the ends of both abutting rails can be ground simultaneously. It is said that under normal service, from 30 to 40 joints can be slotted in an hour.

When equipped with a cup-type of grinding wheel and special guard, the machine can be used to remove the

The Machine Can Be Used for a Wide Variety of Work

flowed-over metal from switch points and stock rails at a grinding-wheel cost of about 10 cents a turnout. If a grinding wheel one inch wide is applied, the tool can also be used to grind the flangeway in frogs and crossings. The cup wheel that is used has a diameter of 6 in. and a face width of 3 in. In addition, a straight cylindrical wheel can be applied for use on crossings and frogs or for other flat grinding.

Power for driving the cross grinder is supplied by a four-horsepower air-cooled gasoline engine which is belt-connected to a flexible shaft nine feet long. The engine is equipped with an oil-type air cleaner which, it is claimed, effectively removes dust and abrasive particles. The engine is controlled by a variable speed governor, by means of which the grinder can be given any desired speed between 4,500 and 6,000 r.p.m. It is thus possible to maintain a constant rim speed on the grinding tool by speeding up the engine as the diameter of the wheel decreases through wear.

The rubber-covered flexible shaft through which the grinding wheel is driven is fully insulated against temperature as well as electric current. For this reason, the operator is relieved of the necessity of exercising care with respect to short circuiting signal circuits, while the grinder can be used in cold or stormy weather with the same facility as in warm or clear weather. All shafts are interchangeable, so that two shafts may be coupled to give a longer reach to the tool. In this way, the power unit can remain on the track or be set off on the shoulder where it will have ample clearance.

The American Gopher in Five New Models

THE American Hoist & Derrick Co., St. Paul, Minn., has placed on the market a new American Gopher shovel-crane-dragline of advanced design. This equipment is available in five sizes and may be operated by gasoline, Diesel or electrical power. It is adaptable for use as a ditcher when mounted on a flat car, for shovel work from the ground, for crane work around yards, and for dragline work, rail handling, etc.

The New American Gopher

The various models of this machine, together with their capacities, are as follows: Model 375, ¾ cu. yd.; Model 400, 1 cu. yd.; Model 425, 1¼ cu. yd.; Model 450, 1½ cu. yd.; and Model 475, 1¾ cu. yd., all being mounted on continuous chain-tread crawler-type trucks, with two speeds. It is said that these models combine all of the latest features known in shovel manufacture, including compactness, simplicity of design, increased strength in all wearing parts, ease and convenience in the operation of the machine and levers that have "fingertip" control.

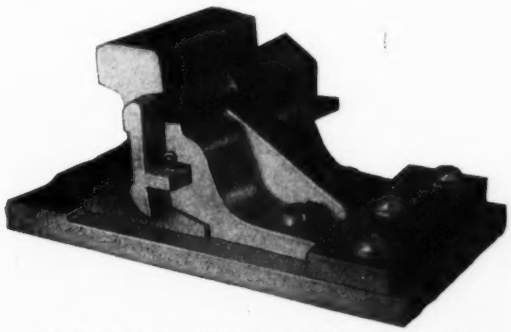
New Adjustable Rail Brace

THE Positive Rail Anchor Company, Chicago, has brought out an adjustable rail brace which embodies a number of new features in the design of such braces. This device, which is known as the Positive adjustable brace, consists of the brace proper, a wedge for obtaining the necessary adjustment, and a cotter pin for holding the wedge in position.

A notable feature of the design of this assembly lies in the fact that the brace proper is applicable to any section of rail between 80 and 131 lb., only the dimensions of the wedge being altered for the various sections of rail. Because of this feature, it is not necessary to maintain a large stock of braces and the availability of the size of brace needed is assured. Another interesting feature of the brace is the design of the wedge in such a manner that contact with the rail takes place only at the web fillets, the edges of the wedge being chamferred so that full contact with the fishing surface of the rail is avoided. Thus it is said that the wave motion of the rail passes freely through the device, thereby eliminating

mechanical wear on the brace and the tie. In addition, the same wedge is said to be applicable to both head-free and standard head rail.

The wedge, which is inserted lengthwise between the rail and the brace, is provided with a horizontal lug extending throughout its length which fits into a groove in the brace. In order that the pressure exerted between the wedge and the brace may be transmitted through the contact surfaces above and below the lug, the assembly is designed so that the lug does not bear at any time against the bottom of the groove. The wedge is held in place by a cotter pin that is inserted through one of a number of holes in the lug at the narrow end of the wedge. When it becomes necessary to adjust the brace



The Positive Adjustable Brace Applied to a 130-lb. Rail

by driving the wedge in farther, the cotter pin is removed and reinserted in the hole in the lug nearest the end of the brace.

The brace proper, which may be riveted to the slide or gage plate in either the shop or the field, is reinforced with a heavy rib, as shown in the accompanying illustrations. In addition to being riveted to the slide plate, the brace bears against a block which also is fastened securely to the slide plate.

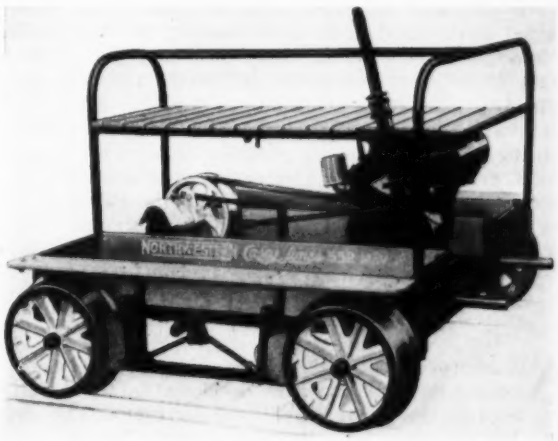
Develops Light All-Service Motor Car

A NEW motor car, known as the Casey Jones 532 light M. W. all-service car, has been developed by the Northwestern Motor Company, Eau Claire, Wis., for light inspection, signal maintenance, section and bridge-gang service. Three distinctive features are embodied in this car, namely light weight, a special tilting countershaft drive and a spring-suspended seat. The car weighs only 500 lb. and is said to be easily removed from or placed on the track by one man, but readily seats five men.

One of the special features, the drive, entails the use of a countershaft mounted over the driven axle by means of links that permit it to be oscillated with respect to the axle, without changing the distance between the sprocket wheels provided for the chain drive from the countershaft to the axle. The pulley mounted on the countershaft for the belt drive from the engine is thus located well above the car frame so that the belt is kept clear of wet grass, snow, etc., and is more easily replaced.

The operation of the car is controlled by one lever which serves both to release and apply tension to the drive belt and to engage and disengage the self-equalizing four-wheel brakes. Incidentally, the throttle and choke handles are mounted on this lever. The car is powered with a Type Z Briggs & Stratton air-cooled, four-cycle, free-running motor with flywheel magneto ignition.

The frame of the car consists of electrically-welded seamless steel tubing of light section. The tool trays are provided with sheet steel bottoms and pressed steel guards at both ends. Another distinctive feature is the



The Casey Jones 532 Light M. W. All-Service Car

spring suspended seat, which is mounted on a pipe frame that serves also as the safety rails, the uprights of this frame being supported on the frame of the car through helical springs at each corner. Other features include standard safety rails, wheel guards, rail skids, and extension lift handles at both ends of the car. The wheels of the car are mounted on aluminum centers having ribs that extend the full width of the tread.

A Light-Weight Rock Drill

AN AIR-OPERATED light-weight rock drill for shallow holes, which is known as the L-1 Light Rotator, is now being offered by the Sullivan Machinery Company, Chicago. This drill is available in solid or hollow piston models, and may be fitted with either a double-grip T-handle or a center single-grip handle, as required by conditions. It weighs 30 lb. and with the T-handle is 17 in. long. Hexagonal drill steel ⅞-in. in diameter and with standard 3¼-in. collar shanks is used. It is said that the L-1 readily drills to depths of from 6 to 8 ft.

The L-1 Light Rotator With Double-Grip Handle

This drill embodies the general features of design that are found in the larger Sullivan rock drills. Every effort has been made in the design, construction and selection of material to secure low weight and simplicity without sacrificing drilling power or resistance to wear or breakage.

The cylinder and valve chest of the drill are drop forged in one piece from special alloy steel while the chuck housing and back head are also steel drop forgings, all these parts being held together by steel side rods. The valve, which is of the Sullivan differential three-spool

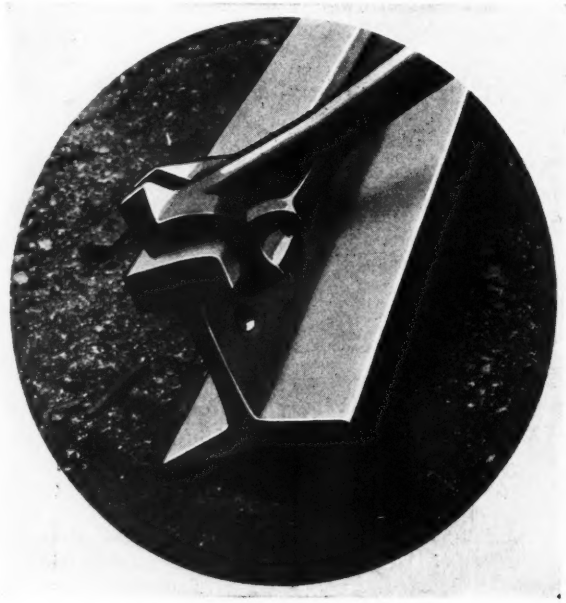
type, is seated in a steel bushing. The throttle is built into the head of the drill, and when it is raised all the way a direct flow of air is admitted into the front side of the piston and into the hollow drill steel to blow the hole free of cuttings or sludge. Automatic rotation of the drill steel is obtained by means of a rifle bar, the rotation taking place on the return stroke after the blow.

The piston is of special alloy steel bar stock, heat-treated and ground to an exact running fit. The chuck is machined from special alloy steel and is broached at the front end to receive the drill steel. The drill steel is held in place in the chuck by a steel coil spring retainer which is secured by lugs on each side of the chuck housing. Rubber grips are provided on both the T and center grip handles, the former being offset while the latter is mounted directly in line with the cylinder for one-hand operation. The entire drill is lubricated from an oil reservoir in a boss in the side of the cylinder.

A Safety Rail Fork

AN improved rail fork, known as the True Temper safety rail fork, has been developed by the American Fork & Hoe Company, Cleveland, Ohio. This device, which consists of a one-piece forging, has an overall length of 40 in. and weighs about 11 lb. The handle is tapering in shape and terminates in a knob having a diameter of 1 5/16 in., which serves the double purpose of keeping the operator's hands from slipping and of preventing the end of the handle from being inserted in rail bolt holes.

The jaws of the fork are designed so that they can grip the rail by either the ball or the base, thus making



A Close-Up of the Improved Rail Fork in Use

efficient handling of rail possible, regardless of how or where it is piled. As the rail is turned beyond the point of balance, the fork releases itself automatically, thereby eliminating an important cause of injury. Another safety feature is embodied in the fact that the rail may be turned away from the operator at all times. Duplication of equipment is rendered unnecessary by the fact that all standard rail sections from 75 to 150 lb. can be handled by the standard pattern fork.

A New Design of Concrete Cribbing

A NEW design of precast reinforced-concrete cribbing, known as Permacrete cribbing, has been introduced by the Prendergast Company, Marion, Ohio. This cribbing is a departure from previous designs, particularly with respect to the appearance of the exposed face of the retaining wall, which is broken up into both vertical and horizontal panels.

Probably the most important feature of this cribbing, from the standpoints of both design and appearance, is the triangular cross-section of the stretchers. These units are 8 ft. 11 in. long; those for the front of the wall are 14 in. high and are laid with the apex of the triangle out, while the rear stretchers are 7 in. high. It is claimed

Progress View Showing Method of Assembling the Units

for this section that it has marked advantages in manufacture, shipping and handling in erection.

The header units are 8 ft. long and 15 in. high, the ends being rectangular in section to provide maximum bearing area. Between these rectangular ends, the section is a modified narrow triangle with the apex forming the top edge to minimize voids in the back filling. There is a horizontal opening through the header at each end into which projections on the ends of the stretchers are placed to form mortise and tenon joints.

A continuous loop is formed around the mortises by the reinforcing bars, which are thus placed in tension when any force is applied to the stretchers. There is sufficient clearance in these joints to provide considerable flexibility in the connection. Slight projections on the top of the end sections of the headers and corresponding depressions on the bottom make them self-centering. The wall is thus broken up into independent panels with continuous vertical joints.

In the event of unequal settlement in a crib wall, some of the members may carry unusual loads. Through the expedient of independent panels and continuous vertical joints, these loads are carried directly to the base of the panel points in the wall, thus largely relieving the load on the stretchers. To minimize the tendency toward settlement, reinforced footing slabs are provided for the headers in high walls to give an end bearing of more than four square feet.

Header units weigh 640 lb. apiece, while the front and

Finished Wall Showing the Paneling Effect

back stretchers weigh 600 lb. and 280 lb., respectively. These weights place the units beyond the range of hand construction, but they can be placed easily with light mobile cranes. The 9-ft. panel length and 15-in. rise per unit make it possible to assemble the wall quickly and at low cost. The stretchers are designed to provide a closed-face wall but with sufficient clearance between stretchers to insure that the wall will be self-draining.

Thackery Double-Coil Springs Hold Plates Rigidly to Ties

A TEST was completed recently by the National Lock Washer Company, Newark, N. J., to determine the effectiveness of screw spikes equipped with double-coil spring washers as compared with cut spikes, when used as independent fastenings for tie plates. A final inspection completing the investigation was made after the tie plates and fastenings had been in service for 15 months.

The track under test was ballasted with rock, with new rail of 130-lb. R. E. section laid in March, 1930,

Thackery Double-Coil Spring

the track having been surfaced shortly thereafter. A general renewal of ties was made at this time, the new ties being machine adzed and creosoted, while such of the old ties as were left in were adzed by hand. The joint fastenings were six-hole, head-free angle bars, equipped with 1⅛-in. bolts and Hipower spring washers.

Double-shoulder tie plates, 8 in. by 12 in., with two transverse bottom ribs and four holes for cut spikes, were applied at the time the rail was laid. The tie plate also had two 15/16-in. round holes on the center line, one near each end, to provide for the installation of either anchor screw spikes or cut spikes as fastenings independent of those used to hold the rail.

For the purpose of this test, the tie plates on one mile of this track were equipped with anchor screw spikes and Thackery double-coil spring washers to permit of a comparison with adjoining track which is similar in every respect, except that the independent fastenings for the tie plates were cut spikes without spring washers. The installation was made between September 22, 1930 and October 5, the final set-down of both types of fastenings being made on October 6, after which no further work was done on them until January, 1932, when the test was completed.

On the latter date an inspection was made of 600 plates, 300 with each type of fastenings, all on a one-degree curve. For this inspection the low rail of the curve was selected as presenting the worst condition of service. Tests were made to determine both longitudinal and vertical movement. Longitudinal movement was found on only one of the plates equipped with the spring washers, while 222 or 74 per cent of those fastened with cut spikes could be moved.

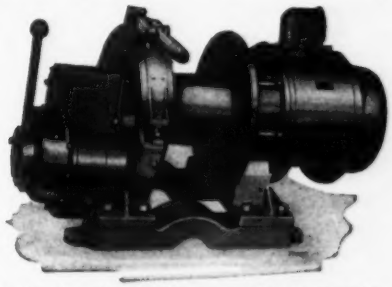
Likewise, none of the plates having spring washers could be moved vertically, although this could be done with 176 or 58 per cent of those fastened with the cut spikes. Following this, another inspection was made from the rear end of a passenger train, at which time the rattling of the plates fastened with the cut spikes was distinctly audible, while no rattling could be detected in those equipped with the spring washers.

It was observed further that some of the plates that showed vertical movement could not be moved laterally, while a few of those with lateral movement were not yet loose enough to move vertically. This was due to the fact that lateral movement depends on the fit of the rail base between the shoulders. On the other hand, plates with both types of fastenings tend to rise and fall with the wave motion of the rail, this action being plainly discernible in the plates fastened with the cut spikes. Although the tendency is the same, the double-coil springs were shown to be effective in resisting this action, holding the plates rigidly to the ties, so that no vertical movement with respect to the ties could be detected.

New I-R Portable Hoists

THE Ingersoll-Rand Company, New York, has added to its line of portable hoists a non-reversible single-drum electric unit, modeled after the company's "Utility" hoists, except that it embodies an electric motor and friction clutch instead of an air motor and jaw clutch. The new type of hoist, which is made in two sizes and four models, designated Nos. 107, 107L, 110 and 110L, is suitable for all single-cable work within its capacity, including hoisting, hauling and the spotting of cars.

Model No. 107 has 7½ hp. and is rated at 2,000 lb. pull at 125 ft. per min. It has a drum capacity for



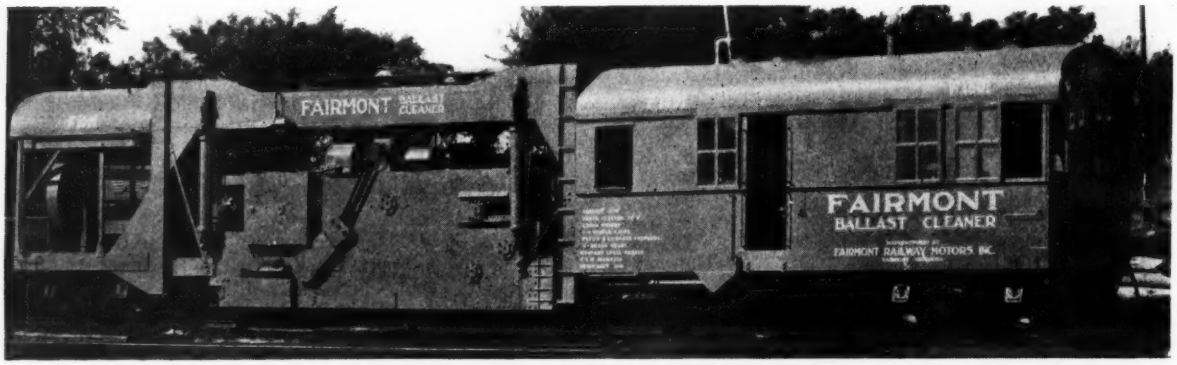
One of the New I-R Single-Drum, Electric Portable Hoists

400 ft. of ½-in. cable or 700 ft. of ⅜-in. cable. Model No. 107L has the same power as No. 107, but its drum capacity is 800 ft. of ½-in., or 1,400 ft. of ⅜-in. cable. Model No. 110 has a 10-hp. motor and is rated at 2,000 lb. pull at 165 ft. per min. Its drum capacity is the same as that of No. 107. Model 110L has the same power as Model 110, and the same drum capacity as No. 107L.

The new hoists are simple, compact, and of rugged construction, and it is said that they are easily operated and have smooth control. They have a self-energizing brake for stopping and holding the load, and an automatic drum lock for added safety when handling suspended loads. Moving parts are protected by dust-proof construction, and the base is drilled and grooved for either column mounting or bolting to a flat surface. The new models can be furnished for operation on either a.c. or d.c. current.

Fairmont Develops Ballast Cleaner of Large Capacity

A BALLAST cleaner of unusually large capacity and flexibility has been developed by Fairmont Railway Motors, Inc. The machine consists essentially of two movable cleaner boxes which contain all of the machinery for cleaning the ballast; the equipment for disposing of the dirt that is removed; and a complete power plant for driving the various units that are required for the cleaning and disposal operations. It will work on either single or multiple track, cleaning one or both shoulders, one shoulder and one intertrack space or two intertrack spaces, simultaneously, and will work through road crossings if desired. The cleaning is continuous and can be done to any depth down to 18 in. below the bottom of the ties. Based on a minimum semi-monthly performance, the cost of cleaning ranges from $0.126 a cu. yd. to $0.186, depending on the type of machine used and whether, on multiple track lines, traffic is diverted for part of the time.



Fairmont Ballast Cleaner with Cleaner Boxes in Traveling Position

Two types of machine are available. One, known as the towing type, requires a locomotive to haul it to and from the work. The other is exactly similar, except it is self-propelled and does not require the service of a locomotive. In both types the entire assembly is mounted on a flat-deck steel car, 67 ft. 6 in. long. The total weight is 198,140 lb. The power plant, which is housed in a steel cab at the front end of the car, consists of a General Electric, 100-kw. generator, driven by a 175-hp. Hall-Scott gasoline engine, for driving the various motors; a 120-hp. gasoline engine for operating the towing drum on the towing type machine; an automatic switchboard with circuit breakers to protect the motors; and the controls for handling the various operations of cleaning and movement of the car.

In another enclosure at the rear of the car, there are two pressure blowers each of which is driven by a 60-hp. gasoline engine, which have a combined capacity of 20,000 cu. ft. of air a minute at a static pressure of 16 oz. These blowers provide the blast to convey the dirt taken out of the ballast to the point of disposal.

Between the cab and the blower enclosure is a frame which supports the cleaner boxes, the movements of which are controlled by 16 oil cylinders working under an oil pressure of 600 lb. to the sq. in. These boxes, together with the equipment which they contain, can be raised and lowered or moved laterally as desired. There is one of these boxes on each side of the car, and when not in use they are raised and drawn on to the car, in which position they are within the standard clearance lines of the A.R.A. The car can, therefore, be moved in regular trains.

The sides of the boxes consist of ½-in. high-carbon steel plates, and all parts which come into contact with the ballast are reinforced with removable plates of similar composition. The inside width of each box is 28 in. At their front lower corners is a pair of high-manganese steel plows, 32 in. high and 28 in. wide, which have a maximum spread of 54 in.

As the boxes are lowered, these plows sink into the ballast, cutting and diverting it into the box. At the same time, at the bottom, an uplifting plow enters under the ballast and raises it up to a flight chain, which carries it over a series of cleaning screens. At the rear of each box is a 50-hp. motor which drives the flight, or cleaning, chain. This motor is reversible, so that if a stone or other object of sufficient size to form an obstruction enters the box, the chain can be reversed to throw it out. Every third link of the chain is formed with a manganese steel flight, 27 in. wide and 9 in. deep, having a curve which effectively flips and rolls the stones as they pass over the cleaning screen.

Integral with the box, but easily removable, this series of manganese-steel screens runs upward from the lower front end at an angle of about 15 deg., over which the ballast is carried by the cleaning chain. After passing over the screens, the cleaned ballast drops into a compartment holding about one cubic yard, from which it is distributed to the shoulder or intertrack space, where it is shaped by a shaper blade.

As it shakes clear, the dirt falls through the screen directly onto the subgrade from which the ballast has been removed. Here another plow picks it up and throws it into a conveyor which drops it into an air ejector, from which the blast that is produced by the fans carries it through tubes to the point of discharge. This dirt can be placed either in a continuous pile on the shoulder of the roadbed or on another conveyor which takes it to an empty car behind the cleaner.

One of these machines was in service on the Baltimore & Ohio from October 8, 1931, to November 12. During this period the maximum sustained performance was 42

Left—Shoulder Cleaned and Shaped, Dirt Piled Along the Shoulder of the Roadbed. Center—The Machine in Operation. Right—Intertrack Space after Cleaning

track feet a minute, when cleaning both the shoulder and the intertrack space, and 105 ft. a min. when working on the shoulder only. The longest days' runs were 8,000 ft. and 14,724 ft. for these respective operations. The train crew time averaged 12 hr. a day and the actual working time averaged 5 hr.

Based on data obtained during this period, taking the minimum semi-monthly performance, it is estimated that with the towing type 2,000 cu. yd. of ballast can be cleaned in a day working one shift, and 4,000 cu. yd. working two shifts. Similarly 2,300 cu. yd. and 4,600 cu. yd. a day can be cleaned in one and two shifts, respectively, by the self-propelled type. In these estimates it is assumed that 7 hr. a shift will be worked by the towing type and 8 hr. by the self-propelled type. In either case, however, it will be necessary to divert traffic a part of the day to make this possible.

Towing Type

Direct Cost of Operation	12 hr.	20 hr.
Operating crew	$ 38.40	$ 76.80
Train and locomotive crews	49.50	99.00
Locomotive expense	60.00	120.00
Supplies	18.80	37.60
Running repairs	22.00	35.00
Contingencies	10.00	20.00
Fixed Charges		
Interest at 6 per cent	$ 40.00	$ 40.00
Depreciation and obsolescence	80.00	120.00
Annual maintenance	53.35	80.00
Total daily cost	$372.05	$628.40

Self-Propelled Type

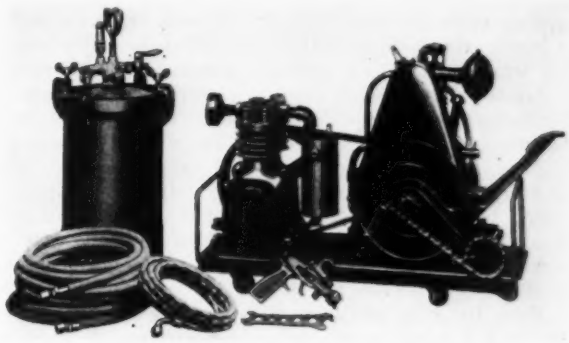
Direct Operating Costs	12 hr.	20 hr.
Operating crew	$ 38.40	$ 76.80
Train crew	28.98	57.96
Supplies	31.30	62.60
Running repairs	28.00	50.00
Contingencies	10.00	20.00
Fixed Charges		
Interest	52.00	52.00
Depreciation and obsolescence	104.00	156.00
Annual maintenance	69.33	103.99
Total daily cost	$362.01	$579.35

The direct costs of operation for both types of machines include the time of the operating crew, which consists of one foreman, two laborers and three operators; the time of train and locomotive crews for the towing type, but not of the locomotive crew for the self-propelled type; the cost of supplies, including gasoline, lubricants, waste, etc.; and of running repairs. Depreciation and obsolescence are figured at the rate of 12 per cent a year where one shift is worked and at 18 per cent for two shifts. Likewise annual maintenance is estimated to be 8 per cent and 12 per cent, respectively, for one and two shifts. When working one shift the crew time is estimated to be 12 hr. and for two shifts the total time is assumed to be 20 hr. On these bases the estimated daily cost of operation is as shown in the table in the previous column.

Translating these figures of daily operating costs into cost per cubic yard, they became $0.186 and $0.157 for the towing type working one and two shifts, respectively. Likewise it is estimated that the self-propelling type working one shift will do the cleaning at a cost of $0.157 a cu. yd., and for $0.126 a cu. yd. working two shifts.

Gas-Powered Spray-Painting Outfit

A LIGHT-DUTY gas-engine-driven spray-painting outfit, known as the NH606, has been developed by the DeVilbiss Company, Toledo, Ohio. This equipment is said to make possible the efficient and economical spray-painting of light or small work at points where electric current is not readily available. It is said that the outfit can be carried by one person but that it is large enough to produce high quality work at a rapid speed.



The New NH606 Spray-Painting Outfit

The outfit consists of one DeVilbiss spray gun with an adjustable spray head and wrench, one 20-ft. length of 5/16-in. air hose and connections, one 12-ft. length of 1/4-in. braid-covered hose and connections, one 12-ft. length of 5/16-in. DeVilbiss fluid hose and connections, one QN 2-gal. paint tank and one NH 1/2-hp. gas-engine-driven compressing unit, mounted on a hand truck. It is said that the outfit is fast, economical and efficient and that no mechanical knowledge is required to operate it.

What's the Answer?

Have you a question you would like to have someone answer?

Can you answer any of the questions listed in the box?

To Be Answered in May

1. Should treated ties be installed with the heartwood up or down? Why?

2. What are the desirable characteristics of a water column? What undesirable characteristics are commonly found?

3. In raising the standard of track construction, involving the application of more and better ballast and heavier rail, if only the ballast or rail is available, should the installation of the ballast precede or follow the laying of the rail?

4. What forms of failure occur most commonly in treated ties on steel bridges? On timber trestles? What are the indications of approaching failure? What can be done to retard or eliminate such failures?

5. What are the effects, if any, of loose bolts on track maintenance? On the riding qualities of the track?

6. Do some wood surfaces hold paint longer than others? If so, why? Is it desirable to mix the paint according to the kind of wood to be painted? If so, what factors should be given consideration?

7. What are the relative advantages and disadvantages of "double stocking" or housing the straight rail at turnouts for the protection of switch points during turnout movements?

8. What methods, if any, other than jacking the bridge, can be employed to restore badly inclined segmental rollers under long heavy spans to proper position?

Deep-Well Pumps

What is the limiting depth (pumping level) for the operation of reciprocating deep-well pumps? What establishes this limit ?

Limited by Cost of Maintenance

By GEORGE L. DAVENPORT

Assistant Engineer, Atchison, Topeka & Santa Fe, Los Angeles, Cal.

The practical limit of depth is 500 ft. below the surface. At greater depths the expense of maintenance increases with alarming rapidity, and even at 500 ft. the results are far from satisfactory. At this depth the quantity of water pumped is of necessity quite limited, so that under modern heavy-traffic demands some better way of raising the water becomes a necessity, both to increase the capacity of the well and to decrease maintenance. The air lift is the practical solution for both of these problems. In this method of pumping, maintenance costs are low while the delivery from the well is increased two or three times, provided the water-bearing strata will yield a sufficient amount to permit this.

Among the principal causes of maintenance expense for reciprocating deep-well pumps are leather and valve failures and breakage or wear of the rods. In a desert country, outfit cars and deep-well gangs ready to go several hundred miles at a moment's notice can be maintained only at excessive cost. Indirect costs, such as result from delays to trains, never show up in the water-service report, but they are real nevertheless, and must be met.

Even for lifts less than 500 ft., there is rarely any excuse for using reciprocating deep-well pumps in railway installations. Deep-well turbines are better adapted for lifts of less than 200 ft. and air lifts for those greater than 200 ft. Occasionally a small section-house supply with a lift of 100 ft. or less can be handled to advantage with a reciprocating pump, although even here, the new type high-speed, small-capacity turbine will be more desirable, provided electric power is available.

As an extreme case, which involved low capacity with high lift, there may be cited an actual installation of an air lift for section use, which raises four gallons a minute from a pumping level 500 ft. below the ground surface to a tank 20 ft. above the surface. This installation requires a 7½-hp. engine, which is belted to a two-stage air compressor. In this case, the low over-all efficiency of seven per cent is offset by the large saving in operating cost, as compared with hauling water a long distance in tank cars or maintaining an expensive pumping plant of the reciprocating type, which would require a pumper. This little air lift is started by the foreman in the morning, and it requires little or no attention, since it stops of its own accord when the engine runs out of gasoline.

Prefers Some Other Type of Pumping

By Supervisor of Water Service

I assume that the practical limit and not the greatest possible operating depth is meant. On this basis, I would place the limit at 300 ft., but I would hesitate to use a reciprocating deep well pump for lifts much in excess of 100 ft., unless driven by necessity to do so. I have seen water lifted as much as 1,000 ft. by a reciprocating deep-well pump, and know of several installations where

the lifts approximate 500 ft. In every one of these cases, however, pump maintenance is high, the power requirement is excessive and the delivery is restricted.

Probably the most aggravating feature of maintenance where the lifts are great, is the frequent failures of pump valves and leathers. Wear on the pump parts may be accelerated by the presence of sand in the water. When repairs are needed, the whole pump must be hoisted from the well and later replaced. This usually is a time-consuming operation, requiring that the well be out of service for a considerable period. Broken rods and rapid wear on the rods add further complications to the problem of maintenance and disturb the continuity of operation, often requiring emergency action.

In every upward stroke of the pumps, power must be used to overcome the inertia, and lift the weight of the pump rods and other reciprocating parts, and no productive work is obtained from the power thus consumed. This loss of efficiency increases both absolutely and relatively as the pumping depth increases.

Both observation and experience indicate that for depths greater than 200 ft. the air lift gives the most satisfactory service. With this type of pumping maintenance is low, because there are no moving parts to get out of order; delivery is increased, in many instances with an equal or smaller consumption of power; and sand and grit cause no wear on the pumping equipment.

Personally, I prefer the turbine type of deep-well pump for all lifts up to 200 ft., although below 100 ft., the advantages of this type over the reciprocating type are not so strongly defined.

Standard Ditches

To what extent can ditches be standardized? What effect, if any, does such standardization have on track maintenance ?

Depends on Cross Section of Cuts

By J. J. HESS
General Roadmaster, Great Northern, Seattle, Wash.

The decision as to whether ditches can be standardized depends largely on the width of the cuts that are to be drained. In my opinion, the cross section of all cuts should provide sufficient room for the subgrade to extend a minimum of one foot beyond the toe of the ballast, and to allow for ditches of ample width and depth. If this is done the ditches can be standardized, danger of scouring the ballast is eliminated and the resulting drainage insures safe and economical maintenance.

Good Drainage Essential to Good Maintenance

By J. J. DESMOND
Division Engineer, Illinois Central, Chicago

Good drainage is essential to good maintenance. Improper or inadequate drainage not only makes track maintenance difficult, but it increases maintenance costs and often results in delays to traffic. Every such delay represents an out-of-pocket cost, but fully as important, it may also affect public good will and confidence.

Haphazard ditching may carry off the water but gives a less favorable appearance to the roadbed. In the last analysis, the final solution of all drainage problems depends on the local conditions, particularly in sections subject to alternate freezing and thawing. It is beyond dispute that no standard ditch can be devised that can be applied rigidly to every situation. This is true of many other standards, however, and does not detract from the desirability of standardization.

In my opinion ditches should be standardized. It is the common experience that they usually provide better drainage than haphazard sections, while the fact that the drainage is uniform is a distinct advantage. Standard ditches can be applied in the vast majority of cases, but deviations should be allowed where conditions render this necessary. Coupled with standard ballast sections and a uniform toe line, they permit quick runoff from the ballast and roadbed and eliminate waterbound track.

Standard Ditch Has Drawbacks

By W. A. BLACKWELL, JR.
Assistant Supervisor, Baltimore & Ohio, Pittsburgh, Pa.

From a practical viewpoint it is impossible to set a standard for ditches which will be suitable for every situation or which will handle the drainage at all points. If the grades are steep, a ditch of standard width and depth may be entirely satisfactory, provided there are no narrow cuts or other obstructions. Where the gradients are light, it is usually necessary to vary both the depth and width to insure that the water will be carried away quickly. In other places, ditches very much deeper and wider than any standard that would be set may be required to care for unusual quantities of water.

Even though there may be many sound reasons for deviating from the standard, it is possible to set a standard that will solve a large majority of the drainage problems. If such a standard is adhered to as closely as possible, good drainage is assured, except in the remaining special cases. If the size and form of the ditches are left to the judgment of an individual, he may not construct ditches which will handle the water to the best advantage. Since good drainage is of the first importance in track maintenance, it is better to have a standard ditch which is known to be adapted for handling the largest part of the drainage problems, than to construct a variety of forms, each intended for purely local conditions.

Preframing Bridge Timbers

To what extent is it practicable to preframe both treated and untreated timber for trestles? What are the relative advantages and disadvantages of doing so ?

Preframing Is Entirely Practicable

By L. H. HARPER
Superintendent Creosoting Plant, Central of Georgia, Macon, Ga.

It is entirely practicable to preframe and prebore all timbers for trestles. In pile trestles, the caps and deck timbers for both open and ballast-deck structures can be completely framed and bored before the timbers are treated. It is understood, of course, that to obtain satisfactory results, all span lengths, heights, etc., must be known in advance, and reasonable care must be exercised in both the framing and the erection.

The main advantage that is obtained from preframing is the longer life that can be expected from the timber as a result of not having to cut or bore into the timber after it has been treated. A very definite advantage, however, is that the treating plant is usually equipped

with power saws, dappers and borers, so that the work can be done more accurately and, at the same time, more cheaply than in the field. If there are any disadvantages in the practice, I am not aware of them.

It is equally practicable to frame non-treatment timbers for trestles at a shop or material yard that is equipped with the necessary power machines. It is quite obvious, however, that the advantages of doing so are not as great as they are in the case of treated timbers.

Would Not Preframe Untreated Timber

By E. A. CRAFT

Engineer Maintenance of Way, Southern Pacific, Houston, Tex.

It is not our practice to construct new trestles of untreated timber, although we use it to some extent for repairs, in which event we do whatever framing is necessary in the field. We do not see where there would be much advantage in preframing untreated timber that is to be used in the construction of new trestles. As a rule this would involve additional haul and an additional handling of the material. Assuming that the field forces are equipped with power tools, the framing can be done on the site of the work at a cost little, if any, more than at a store or shop point.

With treated material the problem is different. It is practicable to do the major part of the framing before treatment and thus obtain complete protection from the preservative. Ordinarily there is also some saving by reason of the use of power equipment for doing the framing. The preframing of timbers that are to be treated does not involve extra haul or extra handling, since the timbers must be unloaded and handled at the treating plant whether or not they are preframed.

Practice Demonstrates Marked Economy

By R. H. GILKEY

Division Engineer, Central of Georgia, Savannah, Ga.

In my opinion, both the practicability and the advantages of preframing timbers before treatment have been demonstrated so thoroughly in practice that the desirability, not to say necessity, of doing so, if full advantage is to be obtained of the cost of treatment, is no longer a matter for discussion.

When it comes to untreated material there may be grounds for a difference of opinion, depending on the source of the timber, the supply, the location of the shop or treating plant in which the framing is to be done, the amount of back haul and the quantity of timber involved. If the season's requirements are known in advance and the framing diagrams are sent to the plant in sufficient time, there is no reason why all untreated timber cannot also be perframed. The advantages are a lower cost for framing and more accurate work, while the time gained by the field forces can be applied to other forms of constructive work. I question the advisability of trying to preframe brace plank, however.

Depends Partly on Interest of Supervisor

By L. G. BYRD

Bridge and Building Supervisor, Missouri Pacific, Wynne, Ark.

While preframing is entirely practicable, the extent to which it is done depends on the interest taken by the supervisor, referring particularly to untreated material for new work and both treated and untreated material used in repairs. My own experience leads me to believe that it can be done economically with all timber used in trestle construction and repairs. During the last few years we have preframed every stick of timber, including ties and brace plank, that has gone into several thousand lineal feet of trestles, ranging in length individually from 34 ft. to 2,000 ft. All holes were bored accurately.

I have found no disadvantage in this practice. It is universally conceded that all timber for trestles that is to be treated should be preframed, and we have extended the practice to include timbers for station platforms. Although the advantages of preframing untreated material are not so pronounced, there is marked economy in doing so, since the work can be done by power machines at about one-third of the cost of hand work, while the machines do it with greater accuracy. Furthermore, much of the work of assembly in the field can be done by unskilled labor.

Maintenance of Curves

From the standpoint of maintenance and operation, what is the most desirable degree of curve? In what way, if any, is this affected by speed, traffic density, character of traffic or type of ballast ?

Considers Curvature of One Degree Best

By W. R. GARRETT

Yard Foreman, Chicago, Burlington & Quincy, Pacific Junction, Iowa

Everything considered, it is my opinion that curves of one degree provide the most desirable conditions of operation and maintenance. A curve of this degree requires only 2 in. to 2½ in. of superelevation for high speeds, while it is but little more difficult to maintain than tangent. Since the curvature is relatively light the rate of curve wear on the outer rail is low, while the small amount of elevation that is required reduces the flattening and rolling out of the low rail to a minimum. Small variations in the alinement are not so noticeable nor do they produce the same riding discomfort as is produced by variations of similar magnitude in lighter curves.

On a curve of this degree the type of ballast does not need to be different from that on tangents, although there should be a little wider shoulder on the outside of the curve. Such a curve does not get center bound readily, provided the tamping is done properly when it is surfaced. The maintenance is affected less by the speed, density and character of traffic than it is for either lighter or sharper curves, and for all practical purposes it may be said that the effect of these factors are about the same as for tangent.

Many Factors Enter This Problem

By E. E. EDWARDS

Section Foreman, Southern Pacific, Frazier, Ore.

So many factors of maintenance and operation enter into this problem that the selection of the ideal curve becomes a difficult matter. Under a given set of conditions one rate of curvature might be ideal, but would be very unsatisfactory under another combination. Speed should be given first consideration in making the selection, this factor being closely allied to the character of the traffic. On multiple track lines where the tracks are assigned exclusively to traffic of certain classes and speeds, the problem is relatively simple, since the superelevation can be made nearly correct for each class of traffic. On any

track, the most undesirable curve from the standpoint of maintenance is one of light curvature.

Curves of very low degree are difficult to line or maintain in line, while the percentage of error for line distortion decreases as the rate of curvature increases. As an illustration, assume a curve of 30 min. over which trains are operated at 70 m.p.h. The practical elevation for this speed is 1¼ in. If any point on this curve, say a joint, should be thrust out one-fourth inch, the curve would approximate 45 min. for a short distance and would call for 2½ in. of elevation. The poor riding condition which is sure to ensue would probably be attributed to a defect in the surface, although the surface might be nearly perfect. Whereas the same amount of distortion on a much sharper curve might scarcely be noticed.

In the past the greatest problem which confronted the maintenance forces with respect to curves was the inability to maintain gage. This trouble is practically eliminated, except for curve wear, as a result of the modern development of tie plates and other track fastenings, which function to preserve the gage. An eight-degree curve, properly equipped with these fastenings, with 5 in. of superelevation is safe for 40 m.p.h. and will give no particular trouble in maintenance, provided it is well ballasted with some suitable material, preferably crushed stone.

As the rate of curvature increases, the rate of the curve wear also increases, thus increasing maintenance costs. Unless the gradient is compensated for curvature, the resistance to train movements upgrade also increases with the curvature. In making a selection to obtain the most desirable degree of curve, all conditions of speed and traffic considered, I would choose one less than 2 deg. 20 min., this being the maximum that trains should be operated over without speed restrictions. As the lower limit I would set 1 degree, in order to eliminate the pronounced effects of small line distortions.

Wide Gage

Under what conditions, if any, is gage wider than 4 ft. 8½ in. permissible? How wide may the gage be allowed to get before regaging is required ?

Recommends Wider Gage on Curves

By W. H. CLEVELAND
General Track Inspector, Atchison, Topeka & Santa Fe, Wellington, Kan.

Gage wider than 4 ft. 8½ in. should be permitted on curves of more than four degrees. On tangents and curves of four degrees and less the gage should not exceed 4 ft. 8½ in. The widening for curves should be made at the rate of ⅛ in. for each degree in excess of four degrees up to a maximum of ¾ in., giving a gage of 4 ft. 9¼ in. for a 14-deg. curve, and this gage should be provided for all curves of higher degree.

Experience has shown conclusively that it is not possible to maintain a standard gage of 4 ft. 8½ in. on sharp curves. Where this is attempted, modern locomotives force the extra width that they require, either by spreading the rails or by canting them outward slowly. When tie plates are not used it is the experience of every trackman that the rails spread. If heavy tie plates are in use, the outward canting is universal, unless the gage is widened properly. Peculiarly enough, this is not particularly noticeable at first and the condition is seldom fully appreciated, since it is not revealed by testing with a gage. The reason for this is that after being tipped out by the locomotive they are returned to their proper seat by the following cars. After a sufficient time the rails will remain permanently in the canted position, by which time they will also have suffered an excessive amount of side wear.

Both of these effects result in shortened life for the rails, and they are not in a position to support the wheel loads properly. In my opinion it is far better to widen the gage a sufficient amount to provide for a free movement for the wheels through a curve than it is to attempt to keep standard gage and permit the locomotives to force the rails out to the width they require. Again, any attempt to maintain exact standard gage is uneconomical because it results in less life for the rail and requires an unreasonable amount of labor.

Standard Gage Prolongs Life of Rail

By HENRY BECKER
Section Foreman, St. Louis-San Francisco, Rush Tower, Mo.

My experience indicates quite clearly that there are no conditions which make a gage wider than 4 ft. 8½ in. permissible for main tracks. Practical considerations make it impossible always to maintain the gage exactly at standard, however, owing to wear on the side of the rail head, to wear on the throat of the spikes and for other reasons. If the gage widens for any reason other than spreading track, it does not become unsafe up to any reasonable limit. As the gage widens, however, the riding qualities of the track decline, and maintenance becomes more difficult. For these reasons track should be regaged when it has widened about ½ in., which is well within the limit of safety. If there are signs of spreading, the track should be gaged at once, regardless of the amount of widening.

Should Be Regaged When ¼ in. Wide

By W. R. GARRETT
Yard Foreman, Chicago, Burlington & Quincy, Pacific Junction, Iowa

On main tracks, particularly if they are high-speed tracks, the gage should always be maintained as 4 ft. 8½ in., the only exception being that occasionally it is permissible to widen the gage from ⅛ in. to ¼ in. on curves carrying high-speed traffic. Experience indicates that such curves are more easily maintained in line and there is a lower rate of curve wear on the rail where this is done. Elsewhere, the only place that this should be done is on sharp turnout curves which carry a heavy traffic and where it is almost impossible to avoid spreading track if this is not done. Here the widening of the gage from ¼ to ½ in. will greatly reduce the tendency to spread. Very close attention should be given to the gaging of the guard rails, however, particularly on the turnout side to insure that they are kept to standard. In my opinion, regaging should be done on main tracks whenever the gage becomes more than ¼ in. wide.

None, Except on Sharp Curves

By W. RAMBO
Roadmaster, Missouri Pacific, St. Louis, Mo.

Gage wider than 4 ft. 8½ in. is permissible only on curves of more than 8 deg. All other track should be maintained to standard gage. For curves above 8 deg. it is permissible to widen the gage ⅛ in. for each increment of 2 deg. or fraction thereof, to a maximum of ¾ in., giving a maximum permissible width of gage of 4 ft. 9¼ in.

It is difficult to answer the second part of the question, since this depends on the tie condition, the weight of rail, the speed and density of traffic, whether tie plates are being used and whether the wide gage is the result of spreading or of rail wear. If the track is actually spreading it should be regaged at once, regardless of the amount of widening or of other factors. I would say that if the track is not spreading, if the tie condition is good, if the gage is uniform and if the wide gage is the result of side wear on the head, it is not necessary to regage until the excess width is greater than ½ in. This is true particularly if tie plates are in use, but in every case where the gage is not uniform, the track should be regaged to improve the riding qualities. Uniform gage is essential to good riding track and should be maintained as near to the standard as practical considerations will permit. I do not wish to be misunderstood as referring to track that has already been widened for curvature when I say that it can be allowed to get ½ in. wide with safety.

Advocates Standard Gage

By ROBERT WHITE
Section Foreman, Grand Trunk Western, Drayton Plains, Mich.

My experience includes employment on several roads and observation on numerous others. I have never seen any case where a gage wider than standard is required on main tracks. It is permissible to widen the gage slightly on sharp curves, but this should never exceed ¼ in. Conversely, the gage should never be tighter than standard. Widening the gage slightly through sharp turnouts will reduce the tendency to spread, particularly if a heavy traffic passes through them. In my opinion, gages less than 4 ft. 8 in. or wider than 4 ft. 9 in. become unsafe and as the gage approaches these limits the track should be regaged.

Measuring Loss of Section

What methods can be employed to determine the loss of section in bridge members that have been subjected to severe corrosion ?

Uses Senses as Well as Instruments

By Assistant General Bridge Inspector

Any methods of locating those parts of a steel structure where reduction of section or other indications of probable failure exists, should be based on an intelligent use of the senses of sight, touch and hearing. It takes several years of field experience for a man with a good technical mind to develop fully this type of intelligence. When developed, however, such a man will always keep in mind the agents that cause corrosion, the method of attack and the relative effect of each. The most important of the causes of corrosion, so far as railway structures are concerned, are brine, locomotive blasts, locomotive fumes, timber surfaces bearing on steel, and cinders or moist earth in contact with the steel. The rating of the span or spans should always be known and a knowledge of any weak details should be kept in mind.

Suspicion is always aroused first by some visual indication. It is beneficial when looking for defects to protect the eyes from strongly contrasted light. A mirror is useful to reflect the sun onto various connections and to show images of otherwise inaccessible parts.

Much can be told about the nature and extent of the reduction in section by feeling with the fingers. Sight and touch often are all that are required in determining whether repairs are needed. After general observations, many of the tentative conclusions can be verified by using a hammer. A light pointed hammer is useful for removing rust or puncturing the steel, while a small machinist's hammer is convenient for sound effects and denting. It is seldom that sufficient indications cannot be obtained by these methods to determine definitely whether repairs are needed.

An inspector should also be provided with 18-in. calipers, which can be slipped over the flanges of most I-beams to measure the thickness of the web. This instrument should be equipped with two screw clamps to retain the measurement after the legs have been opened to remove it from the I-beam. Very accurate results can be obtained with this instrument after a little practice. In substantiating recommendations for repairs, a record of such measurements is often of value.

Only Calipers and Straight Edge Needed

By J. E. BERNHARDT
Bridge Engineer, Chicago & Eastern Illinois, Chicago

Loss of section from corrosion can usually be determined by means of a straight edge, a set of calipers and a scale that is graduated to thirty-seconds of an inch. In general, the members involved are flange angles and cover plates of floor members or of deck girders. With the implements mentioned, it is possible to determine the loss of section with sufficient accuracy for all practical purposes. The thickness of outstanding plates and of the legs of angles can be obtained with the calipers, while the thickness of vertical legs of angles attached to webs can be measured by means of the straight edge and scale.

More refined instruments are available, and in some instances the contour of the surface of members is reproduced by moulding a plastic material to the surface. The simple devices mentioned are sufficient, however, for all but a few special cases.

It is important to select for measurement those sections in which maximum unit stresses will be recorded, even though they may not be the sections which show the greatest loss of metal.

General Deterioration Seldom Encountered

By Assistant Engineer of Bridges

This question directs attention to points of local deterioration. In railway structures a condition of general deterioration is seldom encountered, because of the recognized necessity for a carefully-trained maintenance force charged with the duty of looking after such matters. There are causes of deterioration, however, which are so destructive that no amount of care or effort is effective in arresting their action completely.

To keep structures safe there must be a recognition of the causes of deterioration, among which are brine drippings, blasts and gases from locomotive stacks, accumulations of cinders and rubbish at inaccessible points and improper drainage. There should also be a clear appreciation of the relative or local effects of each factor. As an example, brine drippings affect floor members more particularly. As to relative effects, we might cite for viaducts over track the blasts from locomotives under heavy load, as compared with gases from engines that are not working steam.

A system of inspection is paramount, which will insure a close watch on weakened members and a knowledge that they are receiving the required attention. It is not necessary to use calipers to determine the reduction in section of such members. Their use is likely to limit the repairs to small areas and may result in more costly repairs than would have resulted from the replacement of the members affected, even though only a small area of each one is affected. A small hammer is best adapted for this work. One blade of the hammer should have a pointed end, the other should be a ball head. Members struck with the hammer give off distinctive sounds which are instructive to an experienced inspector, and which indicate clearly the condition of the metal. If conditions are unusually bad, it may be possible to dent or puncture the member. In any case, however, an experienced inspector can determine by means of such a hammer, whether repairs are necessary.

Distributing Crossties

When distributing crossties, should they be stacked in small piles or placed singly at the points where they are to be applied? If the latter, how long before use is this distribution possible ?

Does Not Approve Single Distribution

By W. RAMBO

Roadmaster, Missouri Pacific, St. Louis, Mo.

I do not approve of the custom of distributing crossties singly, unless they are to be applied immediately. Ties that are distributed some time before use should be piled in groups of about 50 approximately at the points of use. All vegetation should be cleaned away around the piles to minimize the fire hazard. Ties unloaded indiscriminately and left lying alongside the track not only make an unsightly appearance, but they create a hazard for trainmen or other employees whose duties require them to walk along the roadbed.

Stresses Exact Distribution

By J. C. HODGE

Section Foreman, Texas & Pacific, Honey Grove, Tex.

One of the basic rules in track maintenance should be to do the work with the greatest economy that is compatible with good practice and appearance. Ties should be distributed in such a manner as to eliminate all lost motion, both at the time of distribution and later when renewals are under way.

To do this there should be as nearly exact distribution of the ties as is practicable when they are unloaded. If the distribution is made well in advance of use, the ties should be stacked in small storage piles at points close to the place of insertion to eliminate the necessity of trucking. If the number of ties to be renewed is very small, some trucking will probably be necessary, as the storage piles will be rather far apart. In general, however, so little time is required to make the final distribution that it can be done late in the day by part of the gang while the remainder is dressing the ballast, or early in the morning while the track is being opened. In either case this operation should not delay the day's work.

If the ties are not received until shortly before use, say within 30 days, it would be useless to pile them, and they should be unloaded directly at the point of use. In this case, however, the distribution should also be made as accurately as practicable. To do this presupposes that the foreman has made a critical inspection of his ties and has recorded carefully the number that will be required in every quarter or, still better, in each eighth of a mile on his section.

Can Be Placed Singly 30 Days Before Use

By R. H. GILKEY

Division Engineer, Central of Georgia, Savannah, Ga.

If the distribution is to be made well in advance of application, the crossties should be stacked in piles of 30 to 50 each. When the renewals are under way, little time is lost in making the final distribution for each day's use. It is often convenient to do this just before quitting time while part of the gang puts the finishing touches on the day's work. Piling the ties in this manner creates an appearance of good housekeeping and reduces the fire risk. If the distribution is made not more than 30 days in advance of use, the ties can be placed singly at the points of use.

Refers to Untreated Ties Only

By ALEX. ANTYMNIUK

Section Foreman, Canadian National, Riverhurst, Sask.

I will refer to untreated ties only. When seasoned ties are distributed for immediate use, they need not be stacked, but may be spotted singly at right angles to the track at the points where they are to be inserted. If they are unseasoned, they should not be inserted until they are seasoned. For this reason, unseasoned ties are generally distributed for use well in advance of application. These ties should be stacked as near the points of use as is practicable and if they are softwood they should be allowed to season a minimum of three months. Ample space should be provided for the circulation of the air. Hardwood ties should season four to five months. Proper seasoning increases the service life of any tie.

Places Them Singly at Point of Use

By J. J. HESS

General Roadmaster, Great Northern, Seattle, Wash.

Within the limits of station grounds, in yards, at crossings and certain other points, we pile the ties until they are to be used to avoid the possibility of personal injury. We do not distribute ties out of cars on high fills as they are likely to roll far below the level of the track. We have found, however, that we can unload the ties for use elsewhere along the line approximately at the points where they are to be inserted and realize an attractive saving by reason of the fact that they do not have to be rehandled, except to avoid obstructing ditches. To obtain a uniform distribution, we divide the number of ties required for any mile by the number of telegraph poles and unload accordingly, thus making a further saving in the cost of handling.

Would Distribute Them Singly

By R. ROSSI

Yard Foreman, Alton, Chicago

Ties should always be piled in yards, at shops and around stations. On main lines outside of yard limits, except at road crossings and near turnouts, they should be distributed singly at the points where they are to be applied. Delivery of the ties required for the season's

renewals should be made between February 10 and March 25.

The stacking of ties that are distributed for use is a serious waste of time and effort, from which there is no constructive return. The cost of piling them, loading them on a push car and of then unloading them can better be applied to the renewal proper, thus reducing the cost of this operation more than is generally realized. In addition, the opportunity for personal injury is increased with every handling.

Should Be Placed in Small Pyramidal Piles

By E. P. SAFFORD
Supervisor of Track, New York Central, Silver Creek, N. Y.

If ties are to be installed economically, a large part of the season's requirements should be on the section before renewals are started. It is our custom to provide the tie-unloading work train with a statement showing the number of ties required for each 500-ft. interval. This gives a nearly exact distribution and the ties are piled in neat, well separated pyramidal piles of 10 to 15 each. As a result, the appearance of the right of way is improved, no trucking is necessary and the fire hazard is reduced to a minimum. Ties that are furnished late and only a short time before use, can be placed neatly along the sod line ready for immediate application where this form of distribution is permitted.

Draining Paved Areas

Where paved areas around stations and freight houses are too wide to permit the usual form of street crowning, what provision can be made for drainage ?

Leads Drainage to Center of Area

By A. T. HAWK
Engineer of Buildings, Chicago, Rock Island & Pacific, Chicago

Paved areas around passenger stations and freight houses are often too wide to admit of the usual method of draining to the curb line as is done in streets. For this reason, other means must be provided for disposing of the drainage. This is usually done by reversing the usual practice, making the area concave with the low point at or near the middle of the paving. The pitch is made as light as practicable and the water is led to a drainage opening with an open grating type of cover similar to that commonly used on manholes.

To do this is not in accordance with good practice, however, since the convex surface makes a stronger paving than the concave type. For this reason, where one is forced to this form of construction by the drainage requirements, reinforcement should be introduced into the foundation course to give the required strength to the paving.

Divided the Area Into Strips

By Division Engineer

I had a case several years ago that was identical with the conditions assumed in the question. The area to be paved was about 800 ft. long and 150 ft. wide. Fortunately, over the greater part of the length, most of the traffic was longitudinal, such transverse movements as were made being at relatively slow speeds. For about 200 ft. at one end there was no general direction to the traffic, as it crisscrossed in every direction.

Except at this end, we divided the pavement into three strips of 50 ft. each, giving each strip a slight crown very much as is done in street paving but not quite so pronounced. This formed relatively wide gutters between the strips, which were pitched to catch basins with open-top gratings that were set flush with the floor of the gutter at proper intervals.

At the end, the pavement was divided into six rectangles about 67 ft. by 75 ft. Each rectangle was made slightly concave and a similar catch basin was placed at the low point. To avoid abrupt changes of grade, vertical curves were introduced between each pair of adjacent rectangles. We had some trouble at these places in getting the water to run away quickly as they were almost flat. This was not a serious matter, however, as it could not collect to any depth. Our most serious difficulty was the keeping of the gratings clear of rubbish during a storm, so that we could dispose quickly of the water that drained toward them.

Porous Materials and Tile Drains

By BURT HURST
Section Foreman, Missouri Pacific, Alma, Ark.

Where conditions occur as presumed in the question, the driveway should be constructed of porous materials such as crushed rock, chatts or, in some instances, locomotive cinders. Water drains through chatts with about the same facility as through river gravel. The most important feature of quick disposition of the surface drainage is ample subsurface drainage. For this reason the driveway should be underlaid with plenty of tile laid with open joints, and the trenches should be backfilled with porous material, preferably cinders.

What of the Organization?

(Continued from page 191)

of the least investment in such equipment. With us, the effect of this has been to organize a system water-service gang, handling the major part of our new construction and heavy repair work on these facilities all over the system—the division organization being limited to maintenance repairmen. We have also organized a system gang provided with the necessary equipment to handle the erection and repairs to steel bridge structures—this unit operating over all of the system, relieving division maintenance organization of work of this character. Similary system paint gangs provided with sand-blasting and spray-painting equipment have been organized to do all of the metal painting work on the system. We also have a rail-relaying gang equipped with all manner of labor-saving equipment."

As stated at the outset of this article, the organization of maintenance work is now in a state of flux; changes of a minor nature are rather widespread but drastic revisions in administration are confined to a relatively small number of roads. In these circumstances it is to be expected that only a few general trends should be discernable at this time. Therefore, although it is certain that the movement toward the revision of current forms of organization will continue apace, there is ample justification for the conclusion that the development period is far from complete and that it will be several years before any of these new organizations will be accepted as generally applicable to the railways as a whole.

News of the Month . . .

Longer Rail Lengths in Germany

The German railways, which began some years ago to increase the length of their rails to 30 meters, are now experimenting with rails 60 meters, or more than 196 ft., long. More than 2,500 miles of track are now laid with 30-meter rails, and over 40 miles have been equipped with rails 60 meters long.

New Safety Record on the Katy

During 1931 the Missouri-Kansas-Texas established the best safety record in its history by completing the year with only 4.7 employee casualties per million man-hours. This compares with a ratio of 38 casualties per million man-hours in 1918 and 6.75 in 1930. There were no deaths of passengers during 1931 and only 6 reportable injuries compared with one death and 27 injuries in 1930.

On-Time Performance Nearly Perfect

What is claimed by the officers of the road as a world's record in on-time performance was made by the Long Island Railroad in 1931, when 99.8 per cent of all passenger trains reached their destinations on time. In March, April, June and October the record was 99.9. The number of such trains operated on this road regularly range from 25,000 to 30,000 a month and the average run is 31 miles.

Holds Highways Cannot Handle All Traffic

In an address at Pittsburgh, Pa., on February 16, Elisha Lee, vice-president of the Pennsylvania, pointed out that even the reduced amount of traffic now handled on one division of his railroad would tax to capacity the William Penn highway between Philadelphia, Pa., and Pittsburgh. Mr. Lee estimated that if the traffic of the Pittsburgh division was transferred to the William Penn highway, some 20,000 five-ton trucks would be required, 14,000 running eastbound and 6,000 westbound, every 24 hours. With such density of traffic, said Mr. Lee, a truck either eastbound or westbound would pass a given point, on the average, every 4⅛ seconds, thereby rendering the highway useless for any other purpose. Referring to these figures, Mr. Lee contends that "they ought to settle the question that the country needs its railroads and cannot get along without them, and that they are plainly in no danger of going the way of the canal, i. e., drying up because something better has been found."

Frisco Employees Get Business

A total of 6,896 cars of freight, 9,823 l.c.l. shipments and 3,003 passengers were secured during 1931 by employee clubs of the St. Louis-San Francisco, located at 64 points on the road, as a result of the individual solicitation of new business by members. By securing 1,870 car loads, 3,210 l.c.l. shipments and 736 passengers during the year, the two clubs at Springfield, Mo., led all others in the camgaign.

I. C. C. Asks Monthly Reports From Carriers

For the purpose of making it possible to keep in close touch with the current financial position of the railways this year when a considerable number of them are in a precarious condition financially and will probably be compelled to apply to the Interstate Finance Corporation and the Railway Credit Corporation for loans, the Interstate Commerce Commission has issued an order to the Class I railroads requiring them to submit monthly a new report of selected income and balance sheet items. These reports, which are to be submitted within 45 days after the close of the month, will contain information that ordinarily is reported only annually and will be in addition to the monthly reports of revenues and expenses.

Many Favor New Flexible Rate Rule and Repeal of Recapture Law

During recent hearings before the committee on interstate and foreign commerce of the House of Representatives, representatives of the Association of Railroad Executives, the Interstate Commerce Commission, shippers and state commissions have indicated that they are in general accord on a plan for revising Section 15a of the Interstate Commerce Act to provide a "flexible" rule of rate making in place of the present rule based on valuation, and for the repeal of the recapture provisions of this section. The proposed flexible rule of rate making would require the commission, when prescribing rates, to give "due consideration among other things, to the existing needs of the public for adequate and efficient transportation facilities and service, to the necessity for enlarging and improving such facilities and service to provide for the growing transportation needs of the public, to the effect of the proposed rates on the movement of traffic and the necessity, in the public interest, that the carriers furnish transportation service at the lowest rates consistent with adequate service and adequate provision for the transportation needs of the public."

Senate Considers Regulation of Highway Transport

During hearings on United States Senator James Couzens' bill to regulate highway transportation, which were commenced before the Senate committee on interstate commerce on February 1, it has developed that many members of Congress are in favor of some regulation of both bus and truck transportation. Early in the hearings there was a general belief that Congress would not be able to reach an agreement on the subject at this session but indications are growing that many members of Congress not on the commerce committee are of the opinion that motor transportation is bringing about a chaotic situation which is also subjecting the railroads to unfair competition under the present condition of discriminating regulation.

Favorable Developments in Railway Field Create Activity

The creation of the Reconstruction Finance Corporation, the establishment of the Railroad Credit Corporation and the acceptance by organized railway labor of a 10 per cent reduction in wages for a year, all of which have taken place since the first of the year, have given an impetus to activities in the railroad field. The Chicago & North Western has announced that prospects for 1932 are sufficiently bright to warrant spending a portion of its $6,000,000 saving on maintenance and equipment, while P. H. Joyce, president of the Chicago Great Western, stated that the financial condition of his road is such as to permit the expenditure of the entire $500,000 saved by the wage reduction for maintenance work. The Atchison, Topeka & Santa Fe states that it will probably spend between

$12,000,000 and $15,000,000 during the year for capital expenditures, such as additions, betterments and improvements. These are only a portion of the announcements regarding increased activities that have been made by various railroads.

Employment Reduced in December

A further reduction of over 35,000 in the number of railway employees between the middle of November and the middle of December has been reported by the Interstate Commerce Commission. The total number of persons in the service of Class I railroads in December was 1,133,923, a decrease of 16.41 per cent as compared with December, 1930. In November the total was 1,169,207. The largest number of employees in service in any month for 1931 was 1,337,331 in May.

R. C. C. Makes Loans

The directors of the Railroad Credit Corporation met in New York on February 24 and approved applications for loans which had been submitted to it. The corporation is not yet in funds but has made arrangements whereby the Reconstruction Finance Corporation will supply the necessary cash until such time as the Credit Corporation begins receiving its advances from the railroads. It was authoritatively announced that there would be no defaults in interest payments due March 1 by roads not in receivership.

Freight Traffic in 1931

Freight traffic transported in 1931 by the railroads totaled 340,148,081,000 net ton-miles, according to complete reports for the year compiled by the Bureau of Railway Economics. This was a reduction of 81,984,610,000 net ton-miles or 19.4 per cent under the total for 1930, and a reduction of 152,165,341,000 net ton-miles, or 30.9 per cent, under 1929. In the Eastern district, there was a reduction of 18.5 per cent compared with 1930; in the Southern district 19.4 per cent and in the Western district 20.6 per cent.

In December, the total was 22,662,901,000 net ton-miles, a reduction of 6,371,196,000 net ton-miles or 21.9 per cent below the same month in 1930. In the Eastern district, the December total was 19.4 per cent under that of the same month the year before, in the Southern district 24 per cent, and in the Western district 24.7 per cent.

I. C. C. Reopens Western Grain Rate Case

Following the decision of the Supreme Court of the United States on January 4, setting aside the order of the Interstate Commerce Commission providing for a general downward revision of grain rates in Western territory, the commission has announced that it will reopen the case for further hearing. Since the court had ordered the issuance of an injunction against the commission's order on the ground that it had denied a rehearing asked by the carriers in view of changing conditions, the commission said the case would be reopened solely on the general question of changed conditions affecting grain and grain products and the transportation thereof since the culmination of the hearing in the case on September 22, 1928. The commission recently authorized the railroads to re-establish the old rates prevailing prior to July 31, 1931, when the lower rates went into effect.

Barge Line Withdraws Low Rates on Cotton

When the Inland Waterways Corporation, the government-owned barge line operating on the Mississippi river and its tributaries, announced a drastic reduction in barge rates on cotton from Memphis, Tenn., to New Orleans, La., on October 6, 1931, opposition to the move from railroad sources was so strong that the Secretary of War suspended the rates until a thorough investigation could be made. The necessity of a formal decision by the secretary has now been removed by the action of the barge line in withdrawing the proposed rates. General T. Q. Ashburn, executive officer of the barge line, made the announcement recently following a conference with railroad and cotton interests.

Movement of Live Stock by Truck Sets Record in 1931

Transportation of live stock from farm to market by truck last year set a new high record, with 21,162,430 cattle, calves, hogs and sheep carried to 17 principal markets throughout the country, according to figures compiled by Charles Snyder, editor of the Chicago Daily Drovers' Journal. Motor trucks hauled 25 per cent more live stock to market than in 1930, and one-third of the total received at these 17 points came over the highway. A steady increase in live-stock trucking is reflected in the figures for successive years, as follows: 1930, 16,947,803 head; 1929, 14,510,524 head; 1928, 12,193,058 head; 1927, 8,393,101 head; and 1919, 2,453,568 head. According to Mr. Snyder, trucking receipts in Chicago increased 44 per cent last year, although 90 per cent of the stock received there still arrives by rail.

Katy Opens New Lift Bridge Across Missouri River

On February 1, the Missouri-Kansas-Texas placed in service a new bridge across the Missouri river at Booneville, Mo., which was constructed to replace an old bridge located 65 ft. upstream and which had been in service for nearly 60 years. The outstanding feature of the new bridge is its through-truss vertical lift span of 408 ft. 4 in., which is said to be the longest railroad lift span in the country. This span provides a clear horizontal opening of 400 ft. for river navigation and when raised has a vertical clearance of 57 ft. above standard high water. The overall length of the bridge is 1,638 ft., with three 300-ft. and one 247-ft. through-truss fixed spans, in addition to the lift span. Another unusual feature of the bridge is the lifting and automatic leveling mechanism which is said to involve features first developed for this bridge and not elsewhere in use. The track on the bridge and approaches is laid with 110-lb. rail and is of the GEO type of construction, the first installation of this type on the Katy.

Proposes Regulation of Western Transport Carriers

Representative Parker, of New York, has introduced in Congress a bill, H. R. 9390, providing that every common carrier by water in interstate commerce, "whether the business of such carrier be publicly, or privately owned and controlled," shall be subject to the jurisdiction of the Interstate Commerce Commission for rate-fixing purposes and that the commission shall have full jurisdiction upon the inland waterways of the United States for the purpose of regulating interstate commerce.

Appoint Committee on Uniform Pension Plan

The advisory council of the Association of Railway Executives, meeting in New York on February 18, appointed a committee to confer with the railway unions on the formulation of a uniform pension plan. The personnel of the committee is as follows: F. V. Whiting (chairman), chairman of the pension board of the New York Central; F. J. Fell, vice-president and comptroller, Pennsylvania; R. M. Hogan of the president's office of the Atchison, Topeka & Santa Fe; W. M. Kennedy, superintendent, relief department, Baltimore & Ohio; G. R. Martin, vice-president, Great Northern; and J. N. Redfern, manager of the relief, medical, employment and pension department of the Chicago, Burlington & Quincy.

Pelley Discusses Highway Regulation

"Regulation," said J. J. Pelley, president of the New York, New Haven & Hartford, in an address on February 11, "is so fair and essential to the proper development of our national system of transport that when anyone objects to all forms of transportation being regulated we must believe that he seeks an advantage which he does not want his competitors to enjoy." Some of the disparities that exist in the laws, or lack of laws, pertaining to the regulation of highway transportation were pointed out by Mr. Pelley. For instance, the annual registration of a three-ton truck in Massachusetts is $19.50, while in North Carolina it is $900. In most states, he said, the registration fees paid by commercial vehicles are so low that private automobiles and the state governments are, in effect, subsidizing the operation of motor vehicles. Furthermore, he continued, highways are now being constructed much stronger and wider and consequently at greater cost than would be necessary if they carried only private vehicles. "Perhaps the most unfair competitive condition that exists," said Mr. Pelley, "is the lack of any regulations governing the hours of labor and the working conditions of men operating commercial vehicles on the highways."

Association News

Tie Producers' Association

The National Association of Railroad Tie Producers will hold its fourteenth annual convention at the Peabody Hotel, Memphis, Tenn., on May 17-18.

Bridge and Building Association

Those members of the association who will be in Chicago during the convention of the A. R. E. A. will meet for lunch in the dining room of the Davis store on Tuesday, March 15, at 12:15 p. m.

Roadmasters' Association

The secretary has sent 1932 membership cards to all members of the association who are in good standing with dues paid in full to December 31, 1931, dues being remitted to such members for the current year by action of the board of directors. The 1932 cards are printed on gold paper, commemorating the fiftieth anniversary of this organization, which it is planned to celebrate this year.

Maintenance of Way Club of Chicago

Seventy-eight members and guests were present at the Auditorium Hotel on Wednesday evening, February 17, when Earl Stimson, chief engineer maintenance, Baltimore & Ohio, was the guest and speaker of the evening following the regular monthly dinner. Mr. Stimson spoke on "Looking Into the Future," with particular reference to the possibility of changes or improvements in the track structure.

Wood Preservers' Association

At a meeting of the Executive committee in St. Louis immediately following the adjournment of the annual meeting on January 28, chairmen were selected to head committees for the ensuing year as follows: Preservatives—W. H. Fulweiler, Philadelphia Gas Wks.; Treatment of Car Lumber—H. R. Duncan, C. B. & Q.; Pressure Treatment of Poles—R. H. Colley, Bell Tel. Labs. Inc.; Non-Pressure Treatment of Poles—J. D. Burnes, Page & Hill Co.; Plant Operation—C. M. Tilley, Tex. Creo. Co.; Tie Service Records—W. R. Goodwin, M. St. P. & S. S. M.; Bridge & Structural Timber—G. A. Haggander, C. B. & Q.; Marine Piling Service Records—M. F. Jaeger, Port Reading Creo. Plant; Pole Service Records—H. A. Haenseler, W. U. Tel. Co.; Post Service Records—R. T. Huson, K. C. S.; Diversified Uses of Treated Wood—E. P. Gowing, Am. Creo. Co.; Special Committee on the Effect of Treatment on the Inflammability of Wood—George E. Hermann, Vancouver Creo. Co.

Those members of the Executive committee who are in attendance at the A. R. E. A. convention will meet at lunch on Wednesday, March 16, to discuss plans for the summer meeting of committees.

American Railway Engineering Association

The thirty-third annual convention will be held in the Palmer House, Chicago, as in the recent past, but as was done last year the meeting will be limited to two days, March 15 and 16. The program follows:

Tuesday morning—9 A. M.

President's address, L. W. Baldwin, president, Missouri Pacific
Reports of secretary and treasurer.
Reports of Committees on:
- Uniform General Contract Forms
- Iron and Steel Structures
- Wooden Bridges and Trestles
- Clearances
- Electricity
- Signals and Interlocking

Tuesday afternoon—2 P. M.

- Yards and Terminals
- Shops and Locomotive Terminals
- Standardization
- Maintenance of Way Work Equipment
- Rules and Organization
- Grade Crossings

Tuesday evening—8 P. M.

- Rivers and Harbors
- Roadway
- Stresses in Railroad Track
  - (1) Some features of the rail joint
  - (2) The desirability of reducing to a minimum the present variability factor in track

Wednesday morning—9 A. M.

- Economics of Railway Operation
- Economics of Railway Labor
- Water Service and Sanitation
- Buildings
- Masonry
- Waterproofing of Railway Structures
- Records and Accounts

Wednesday afternoon—2 P. M.

- Ballast
- Ties
- Wood Preservation
- Rail
- Track

A part of the report of the Committee on Stresses in Track on Tuesday evening will be illustrated by a series of lantern slides. A distinctive feature of the convention will be a luncheon served in the Red Lacquer room on Wednesday noon for members of the A. R. E. A., the National Railway Appliances Association and their guests. This will be followed by a short program during which Claude R. Porter, chairman, Interstate Commerce Commission, will speak.

Three committee meetings to consider the assignments for the coming year were held during February. The Committee on Iron and Steel Structures met at Columbus, Ohio, on February 4 and 5, and the committees on Grade Crossings and on Shops and Locomotive Terminals at Chicago on February 2 and February 10, respectively. Several committees are arranging to hold meetings during the convention.

Personal Mention

General

F. C. Wilkinson, who has been on special duty in the office of the chief engineer of the Pennsylvania, at Philadelphia, Pa., and who has served in the engineering and operating departments of the Pennsylvania for 27 years, has been appointed superintendent of the Logansport division of that road, with headquarters at Logansport, Ind. Mr. Wilkinson was born at Elmira, Ohio, and

F. C. Wilkinson

was educated at Ohio State University. He entered railway service in 1905 as an assistant on the engineering corps of the Pennsylvania, and served in various positions in the engineering and operating departments until 1928, when he was appointed assistant trainmaster on the Allegheny division. Later he was assigned to special duties in the office of the chief engineer, where he remained until his promotion to superintendent of the Logansport division.

Engineering

L. C. Sprague has been appointed consulting engineer of the Louisiana Southern, with headquarters at New York.

D. M. Howard, assistant division engineer of the Philadelphia Terminal division of the Pennsylvania, at Philadelphia, Pa., has been transferred to the Philadelphia division.

E. B. Wiseman, assistant to the division engineer of the Renovo division of the Pennsylvania, with headquarters at Erie, Pa., has retired, and the position of assistant to the division engineer at Erie has been abolished.

Maro Johnson, who has been appointed principal assistant engineer of the Illinois Central, to succeed **Arthur L. Davis,** retired, as noted in the February issue, has served in the engineering department of this road for nearly 34 years. He was born at Iowa City, Iowa, in 1877, and

graduated from the University of Iowa in 1898, with a degree in civil engineering. He entered railway service in October of the same year as a masonry inspector on second track work on the Illinois Central, and after holding various positions in the bridge department he was sent to Indianapolis, Ind., in March, 1905, as resident engineer on the construction of the

Maro Johnson

Indianapolis Southern (part of the Illinois Central). Two years later Mr. Johnson was appointed resident engineer on track elevation work at Chicago, being promoted to assistant engineer of bridges in 1912, and then to engineer of bridges and buildings in 1913. Two years later he was appointed resident engineer in charge of the design and construction of the St. Charles Air Line bridge over the Chicago river at Chicago. Mr. Johnson was assigned to the chief engineer's office in 1920, as an assistant engineer, where he handled special assignments including that of representative in planning Chicago terminal improvement work, various grade separation projects, and the passenger terminal at New Orleans, La. His appointment as assistant principal engineer at Chicago became effective on January 1.

George S. Lovering, assistant chief engineer of the Minneapolis & St. Louis, with headquarters at Minneapolis, Minn., has also been appointed superintendent of telegraph and signals for the system. The telegraph work has heretofore been handled through the offices of the division superintendents.

E. S. Pennebaker, principal assistant engineer of the Texas & Pacific, with headquarters at Dallas, Tex., has been appointed manager of the Texas Pacific-Missouri Terminal Railroad of New Orleans, La., in charge of all departments. Mr. Pennebaker has been in the service of the Texas & Pacific since 1916. He was born on June 14, 1886, at Cairo, Ill., and graduated from the University of Illinois in 1910. In August, 1904, prior to entering college, he entered railway service with the Mobile & Ohio, where he served successively as rodman, topographer, draftsman and instrumentman at Cairo. During the summers from 1906 to 1910 when he was in school, Mr. Pennebaker served in engineering capacities with various railroads. In June, 1910, he became a resident engineer with the W. H. Zimmerman Company, Chicago, returning to the service of the Mobile & Ohio a year later as chief clerk and office engineer in the engineering department at Mobile, Ala. In October, 1912, he entered the service of the Union Railway of Memphis, Tenn., where he served until September, 1916, when he entered the service of the Texas & Pacific at New Orleans, as contract assistant to the receiver, being sent to Dallas in November, 1917, as assistant engineer. Less than a year later, Mr. Pennebaker was made assistant to the chief engineer of Group 5, Southwestern region, of the United States Railroad Administration, and in December, 1918, he was appointed corporate engineer for the receivers of the Texas & Pacific, being promoted to principal assistant engineer of that road in July, 1924.

Track

J. Kilpatrick, roadmaster on the Canadian Pacific, with headquarters at Souris, Man., has been transferred to Reston, Man., to succeed **G. L. Thorne,** who has been transferred to Lloydminster, Sask., to replace **J. Stewart,** who has been granted a leave of absence.

C. I. Jones, roadmaster on the Atchison, Topeka & Santa Fe, with headquarters at Fresno, Cal., has been transferred to Parker, Ariz., where he succeeds **E. L. McDonald,** who has been assigned to other duties. The territory over which Mr. Jones formerly exercised jurisdiction has been assigned to other roadmasters.

F. L. Brown, assistant supervisor on the Pennsylvania, with headquarters at Earnest, Pa., has been transferred to Middletown, Pa., to succeed **P. M. Roeper,** who has been promoted to supervisor with headquarters at Hollidaysburg, Pa. Mr. Roeper will succeed **J. R. Stam,** who has been transferred temporarily to the Trenton branch.

J. A. Leslie, roadmaster of the Ashcroft subdivision of the British Columbia district of the Canadian National, with headquarters at Kamloops, B. C., who has been on a leave of absence since October 15, 1931, because of an injured ankle, has returned to service as roadmaster of the Okanagan and Lumby subdivisions, with headquarters at the same point, succeeding **C. E. Scanlon,** who has been assigned to other duties. At the time of Mr. Leslie's injury, he was succeeded as roadmaster of the Ashcroft division by **H. Gunderson,** roadmaster of the Okanagan and Lumby subdivisions.

Alfred T. Sughrue, assistant supervisor of track on the Boston & Maine, with headquarters at Nashua, N. H., has been promoted to supervisor of track with headquarters at Rochester, N. H., where he succeeds **R. H. Mitchell,** who has been transferred to Portsmouth, N. H. Mr. Mitchell succeeds **Algie E. Cluff,** who has been transferred to Dover, N. H., succeeding **Andrew Lahey,** who has been transferred to Lawrence, Mass., to replace **Patrick J. Higgins,** who has been assigned to other duties. **Harry C. Cheney** has been appointed assistant supervisor of track at Nashua, to succeed Mr. Sughrue.

Following a consolidation of supervisors territories on the Illinois Central, **S. C. Jump,** supervisor on the Springfield division, has had his headquarters moved from Bloomington, Ill., to Clinton, and **Frank T. Kraft,** supervisor at the latter point, has been assigned to other duties. **F. J. Coates,** supervisor on the St. Louis division, at Christopher, Ill., has also been assigned to other duties, and his territory has been distributed among other supervisors.

Bridge and Building

Following the abolition of the position of superintendent of bridges and buildings of the Chicago, St. Paul, Minneapolis & Omaha, **Andrew G. Rask,** who held that position, with headquarters at St. Paul, Minn., has been appointed general foreman of bridges and buildings at Altoona, Wis., succeeding **E. Gunderson,** who has been transferred to Spooner, Wis. Mr. Gunderson replaces **C. Sedmoradsky,** who has been transferred to Worthington, Minn., where he succeeds **T. H. Thompson,** who has been appointed system scale inspector, with headquarters at St. Paul. Mr. Thompson relieves **R. O. Rask,** who has resigned.

John E. Bebb, assistant bridge engineer of the Michigan Central, has been promoted to bridge engineer, with headquarters as before at Detroit, Mich., to succeed **Gabriel C. Tuthill,** who has retired. **Hans Ibsen,** consulting bridge engineer for this road, at Detroit, who was

John E. Bebb

bridge engineer from 1905 to 1916, has also retired. These changes became effective on February 1.

Mr. Bebb has been engaged in railway engineering work on a number of roads for nearly 27 years. He was born on February 12, 1883, at Cincinnati, Ohio, and was educated at the University of Cincinnati, from which he graduated in June, 1905, with a degree in civil engineering. While in college, Mr. Bebb spent a number of summers as a rodman on the Cleveland, Cincinnati, Chicago & St. Louis. Immediately after his gradua-

tion he entered the service of the Michigan Central, at Detroit, Mich., as a structural draftsman in the bridge department, and served in this capacity and as bridge inspector until 1910, when he was appointed office engineer in the bridge department. He left the Michigan Central in July, 1912, to accept a position as office engineer for the Duluth, South Shore & Atlantic and the Mineral Range Railroad,

Gabriel C. Tuthill

with headquarters at Duluth, Minn. Mr. Bebb returned to the Michigan Central in January, 1917, as assistant bridge engineer at Detroit, in which capacity he served until 1925, when he was placed in charge of the grade separation department, although retaining the title of assistant bridge engineer.

Mr. Tuthill has been connected with the bridge department of the Michigan Central for nearly 41 years. He was born on January 1, 1865, at Washingtonville, N. Y., and received his education at the University of Michigan, from which he graduated with a degree in civil engineering in 1891. Prior to graduation, Mr. Tuthill engaged in railway location and

Hans Ibsen

construction work on lines which now comprise parts of the Pere Marquette and the Wabash. In July, 1891, he went with the Michigan Central as a structural draftsman and bridge inspector at Detroit. In 1896, Mr. Tuthill was promoted to assistant bridge engineer, in which capacity he supervised the construction of a number of important bridge projects. He was advanced to bridge engineer on November 1, 1916, which position he held continuously until his retirement.

Mr. Ibsen has been engaged in engineering work for 59 years, more than 41 of which have been in the bridge department of the Michigan Central. He was born in 1862, at Bergen, Norway, and after an education in the schools of that country, he came to the United States at the age of 20 years, where he engaged in preliminary work on a projected line of railroad in Pennsylvania. For a time Mr. Ibsen served with the Riverside Bridge & Iron Works at Paterson, N. J., and later in the office of the city engineer of St. Paul, Minn., as a draftsman. In 1889, he went to Norway for further technical study, returning to the United States in May, 1890, to enter the bridge department of the Michigan Central, being advanced to bridge engineer in August, 1905. In November, 1916, Mr. Ibsen was appointed consulting bridge engineer of the Michigan Central, in which capacity he served until his retirement. During this time he was in complete charge of the design and construction of a number of notable structures for the Michigan Central.

Obituary

M. A. Smith, general foreman, maintenance of way department, on the Illinois Central, with headquarters at New Orleans, La., died on January 18, of a stomach disorder.

C. H. Fake, who retired in 1918 as engineer maintenance of way of the Mississippi River & Bonne Terre (now part of the Missouri Pacific), died on December 31, at Salem, Ore., as the result of a stroke last August. From 1903 to 1914, Mr. Fake was chief engineer of the Mississippi River & Bonne Terre, being appointed engineer maintenance of way in the latter year.

Dan Burke, supervisor of bridges and buildings on the Southern Pacific, Pacific Lines, with headquarters at Tucson, Ariz., died on December 31. Mr. Burke was born in 1865, and entered the service of the Southern Pacific in 1903 as a carpenter on the Los Angeles division, later being promoted to bridge and building foreman. In 1909, he was advanced to supervisor of bridges and buildings at Tucson, which position he held continuously until his death.

Robert Trimble, formerly assistant chief engineer of the Pennsylvania System, died on February 6 of pneumonia at Glen Osborne, Pa., a suburb of Pittsburgh. Mr. Trimble was born at Butler, Pa., and was educated at the Western University of Pennsylvania, now the University of Pittsburgh. He entered railway service in 1875, as a chainman on the engineering corps of the Pennsylvania, and advanced through various positions to that of principal assistant engineer. In 1903, Mr. Trimble was promoted to chief engineer maintenance of way of the lines west of Pittsburgh, Northwest System, which position he held until July 2, 1918, when he was appointed chief engineer of construction of the same lines. He was further advanced to assistant chief engineer of the Pennsylvania System with direct supervision over the lines west of Pittsburgh on March 1, 1920, and was appointed chief engineer of the Pennsylvania Company and of the Pittsburgh, Cincinnati, Chicago & St. Louis (part of the Pennsylvania) in July, 1926. He was serving in the latter capacity at the time of his retirement on December 31, 1926.

George P. Turner, valuation officer of the Union Pacific System, with headquarters at Omaha, Neb., who died on January 7, as announced in the February issue, had been in railway engineering and valuation work for 30 years. He was born on December 18, 1879, at Rudd, Iowa, and graduated from Cornell College, Mt. Vernon, Iowa, in 1903. Prior to graduation, he served as a rodman, instrumentman and inspector of construction work on the Minneapolis & St. Louis. In May, 1903, immediately after graduating from school, he entered the service of the Illinois Central as a resident engineer, and served in this position and as an assistant engineer until July, 1908, when he left railway service to be-

George P. Turner

come connected with a railway contracting firm at Louisville, Ky., as engineer and assistant superintendent on a project of the Cleveland, Cincinnati, Chicago & St. Louis, at Indianapolis, Ind. In May, 1909, Mr. Turner entered the service of the Union Pacific as an assistant engineer, being assigned to valuation work on January 1, 1914. In June, 1915, he was appointed assistant to the special engineer of the Union Pacific System and the Southern Pacific Company, on valuation work. When the valuation department of the Union Pacific was organized on January 1, 1917, Mr. Turner was made valuation engineer of the Union Pacific Railroad, and on October 15, 1918, he was promoted to valuation officer of the system, which position he held until his death.

"Rocket" on Display. A full-size replica of the world's first locomotive, the "Rocket," was placed on display in the Chicago Union Station concourse on February 6. It was purchased from Robert Stephenson & Company, Ltd., of Darlington, England, by the Museum of Science and Industry of Chicago.

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Supply Trade News

General

The Barber-Greene Company, Aurora, Ill., has appointed the **Boehck Equipment Company,** Milwaukee, Wis., its representative in that state.

The Ramapo Ajax Corporation, New York, has taken over the manufacture and sale of the metal highway crossing pavement of the **Locomotive Finished Material Company,** Atchison Kan., which it is now handling under the name of the Racor-Universal permanent highway crossing.

The Chipman Chemical Engineering Company, Inc., Bound Brook, N. J., has changed its name to the **Chipman Chemical Company, Inc.** There has been no change in the organization or corporate structure, and no change is contemplated in the policy or activities of the corporation.

Personal

William J. Allen, treasurer of the **St. Louis Frog & Switch Co.,** St. Louis, Mo., died on February 18.

C. L. McMullen has been appointed manager of engine sales in the special sales division of the **Caterpillar Tractor Company,** Peoria, Ill.

C. E. Wilson, general sales manager of the **Worthington Pump & Machinery Corporation,** has been appointed vice-president in charge of industrial relations with headquarters as before in New York. **Clarence E. Searle,** general representative in charge of sales for the Allis-Chalmers Manufacturing Company, has been appointed vice-president in charge of sales of the Worthington Pump & Machinery Corporation, with headquarters also at New York.

C. E. Wilson

Mr. Wilson entered the service of the Worthington organization in 1899 as a salesman in the Chicago office, being promoted to sales manager at that point in 1905. Later Mr. Wilson was made assistant general sales manager in charge of foreign business, which position he held until 1923, when he was made general sales manager.

Clarence E. Searle

Mr. Searle became connected with the Allis-Chalmers Company in 1908, after serving for a time with the Western Electric Company and the Fort Wayne Electric Works. In 1910 he was advanced to district manager of the Milwaukee office of Allis-Chalmers, which position he held until 1915, when he was made general representative in charge of sales.

A. E. Ballin, formerly president of the **McIntosh & Seymour Corp.,** has been elected vice-president in charge of sales and engineering of the **Nordberg Manufacturing Company,** Milwaukee, Wis.

J. F. Mehlhope, formerly Chicago district sales manager for the Central Alloy Steel Corporation and later for the Newton Steel Company, has joined the sales force of the **Chicago Steel Service Company,** warehouse distributors for Toncan iron and Enduro stainless steels, products of the Republic Steel Corporation, Youngstown, Ohio. The Chicago company has recently remodeled and enlarged its offices and warehouse facilities.

With a view to rendering improved service to the railways, **Fairbanks, Morse & Co.,** Chicago, has established six district railroad sales offices. **C. H. Wilson,** who for some years has represented the company on western lines in Houston, Tex., St. Louis, Mo., and Chicago, has been placed in general charge of railroad sales, with headquarters in Chicago. The requirements of the railroads will hereafter be handled from the district offices with **E. P. Vroome** manager of railroad sales at the New York district office; **H. E. Vogel** at Baltimore, Md.; **W. L. Nies** at Chicago; **W. B. O'Niel** at St. Louis, Mo.; **G. Howard** at St. Paul, Minn; and **L. H. Matthews** at San Francisco, Cal. Among the representatives of the company who will operate from these offices are **E. P. Chase** and **R. F. Lane** at New York; **F. C. Snyder, E. C. Golladay** and **B. S. Spaulding** at Chicago; **E. J. Coverdale** at Washington, D. C.; **C. T. Fuggitt** at Atlanta, Ga.; and **C. A. Rauch** at Houston, Tex. Contracts for the erection of coaling stations and the installation of sand, coal and cinder handling machinery are in charge of **W. F. Anderson** at Chicago, with **J. C. Flannagan** and **J. T. Frame** as representatives.

Trade Publications

International-Stacey Products — The International-Stacey Corporation, Columbus, Ohio, has issued a folder containing a complete list of the products of the various divisions of this company..

Caterpillar Equipment.—The Caterpillar Tractor Company, Peoria, Ill., has published a condensed catalog of 32 pages, which describes and illustrates this company's complete line of road machinery, many items of which are equally applicable to railroad work.

42-B Electric Shovel—The Bucyrus-Erie Company has issued a 20-page bulletin devoted to an exposition of its new 42-B electric shovel which is designed for use with a 1½-yd. dipper and is also available as a dragline and clamshell and lifting machine. The component parts of the equipment are adequately illustrated.

Protective Coatings—Armco Engineering Bulletin No. 4, Vol. 1, is devoted to protective coatings for Spiral Welded Pipe. Six different protective coverings are described and data given on the service they render, with suggestions as to the type of service for which each is best adapted. There are six pages of text matter and one chart.

Modern Water Storage.—The Pittsburgh-Des Moines Steel Company, Pittsburgh, Pa., has issued a 28-page catalogue, bearing this title, which deals comprehensively with the various applications of elevated tanks for the storage of water. This booklet is attractively illustrated and contains standards and specifications for Pittsburgh-Des Moines tanks.

Tanner Tanks and Tannergas.—The Sullivan Machinery Company, Chicago, has issued Bulletin No. 100-C, in which the method of preventing the freezing of the air lines on pneumatic tools by the use of Tannergas and Tanner Tanks is described and illustrated. The bulletin also describes the many different operations to which this anti-freeze may be applied, and instructions for its application are also given.

Wrought Iron Plates—The A. M. Byers Co., Pittsburgh, Pa., has issued a folder giving particulars concerning its sheared and universal plates which are now to be had in a range of sizes that have not been available in wrought iron for 25 years. In addition to suggested specifications and a card of price differentials and extras, the folder contains tables of standard thicknesses, widths and lengths.

ALPHABETICAL INDEX TO ADVERTISERS

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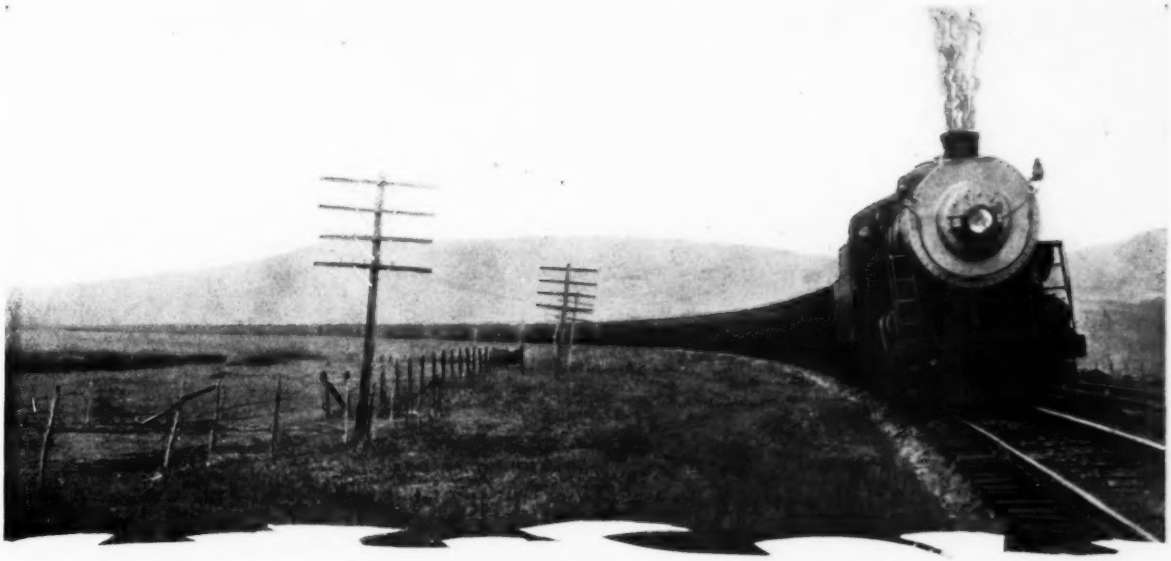

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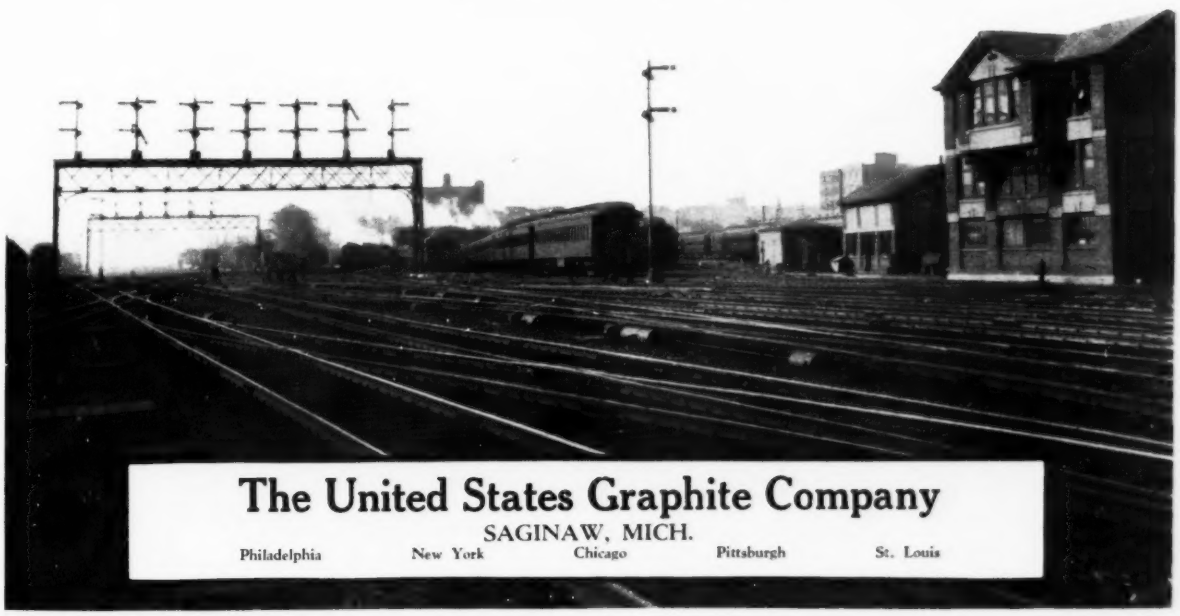

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Philadelphia New York Chicago Pittsburgh St. Louis

THE TIMKEN LOCOMOTIVE

100,000 miles without bearing trouble

A revolutionary accomplishment in locomotive operation

Again Timken has successfully pioneered a great forward step in anti-frictionization, and as a result, another important chapter has been added to the history of railroad development.

The Timken Locomotive was the first locomotive in the world to be completely equipped with anti-friction bearings on all axles—leading truck, driving wheels, trailer truck and tender trucks.

It was built by Timken to demonstrate the advantages of Timken Bearings in locomotive operation, and was placed in service on April 15, 1930. In January this year, the Timken Locomotive completed its official service test of 100,000 miles. This mileage was made on 14 railroads in regular passenger and freight service, and under every conceivable running condition.

Tough as locomotive operation is on bearings, the Timken Bearings in the Timken Locomotive have given no trouble whatever. No bearing repairs or replacements have been made.

Railroad master mechanics and engine foremen know what this remarkable performance means... the savings it will effect in locomotive maintenance... the dependability it assures.

And the same exclusive combination that has enabled Timken Bearings to do what had never been done before in all railroad motive power experience, has assured more economical operation; more efficient performance; greater dependability; and lower maintenance cost in passenger cars, section motor cars and trailers and other railroad equipment for years.

That combination is Timken tapered construction; Timken positively aligned rolls; and Timken-made steel—the combination that eliminates friction and carries all radial, thrust and combined loads at the same time.

THE TIMKEN ROLLER BEARING COMPANY, CANTON, OHIO

TIMKEN *Tapered Roller* **BEARINGS**